

NUTS & VOLTS

M A G A Z I N E



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VOL. 14 NO. 7

JULY 1993

A National Publication For The Buying And Selling Of Electronic Equipment

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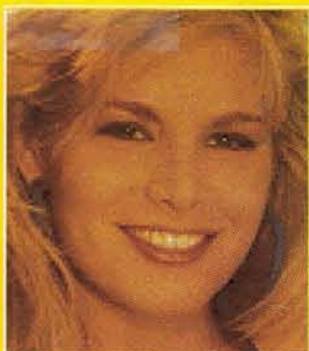
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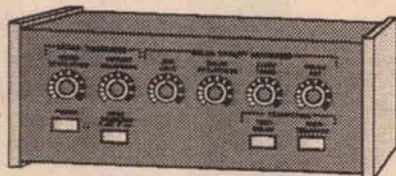
Get ready for Summer with a great deal from HSC!

Now Available...New HSC Catalog!!
Months in the making... our new 48-page catalog listing thousands of electronic essentials! Send \$1.00 (or free with order) and thanks for waiting patiently!

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HSC# 13978 **\$49.95**



Versatile & Indispensable!

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HSC# 14049 **\$22.50**



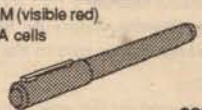
Budget Disk Drive Case/Power Supply

Here is the answer to your expensive disk drive enclosure blues...a large manufacturer bought these units to remove the drives and had leftover cases. What to do? Sell them to you! Plastic case and bracket with beefy linear power supply will work with any half-height 5.25" drive (needs drive power connector, cable exit hole).
HSC# 13850 **\$19.95**



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You've seen these advertised before at \$175, or maybe \$150... but now HSC is able to offer the latest high-tech gizmo at a more affordable price! Solid state laser diode puts out 4mW at 660 - 680 nm (visible red) wavelength. Uses two AAA cells (included) and comes in a handsome presentation case with 1 year warranty.
HSC# LDP BLACK **\$97.95**



Small Power Supplies, Big Savings!

These tiny (3" x 5" x 1.5") switching power supplies by Protek are small in size only! They are big on performance and value, and are perfect for use with 3.5" or smaller hard disk drives. 110 or 220VAC input, 5VDC @ 3A, 12VDC @ 2A, -12VDC @ .3A output. Similar to illustration.
HSC #13728 **\$14.95 ea. Special!**



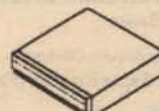
Stash of MFM Controllers found... Hurry before they Vanish!

That's right...these 16-bit (AT bus) MFM Hard Disk controllers represent the last of a vanishing breed! No one is making MFM controllers anymore, so if you have a MFM drive or two and don't have a controller, you definitely need one of these. Everex EV-349 supports two floppies and 1:1 interleave for up to two MFM hard drives. LED output for connecting to your drive activity light. Latest surface-mount technology means rugged reliability and low power consumption. Brand new in antistatic bag, cables not included. Sorry, no docs yet. There are plenty of MFM Drives out there on the secondary market, but controllers are another matter...hurry!
HSC#14043 **One year warranty! \$39.95**

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All drive enclosures feature fan-cooled power supplies, SCSI address switches and ICN50 connector knockouts. Styles A&B include ribbon cable, the others do not. Inquire about our selection of SCSI cables when ordering.

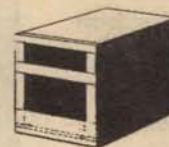
A. SKHD1	55W P.S., Room for single internal drive, fits under a Mac!	10" x 10" x 2.25"	\$99.95
B. SKHD1/Open	55W P.S., Same as above, but with 5.25" front opening	10" x 10" x 2.25"	\$99.95
C. SLHD2	60W P.S., Front opening for two half-height drives.	7.5" x 12" x 6.5"	\$119.95
D. SLHD3	60W P.S., Front openings for three half height drives	7.5" x 12" x 9"	\$139.95



Style "A", "B"



Style "C"



Style "D"

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This is the type of deal we love to offer our customers, because it has so much potential. We bought these items for the neat case, but then discovered that the unit inside has a wealth of possibilities. We offer some suggestions, let your imaginations run wild!

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Option #2 -- Frequency Converter Unit (removed from case above) Mod. CV-2353/U was used to mix external signals from 100 Hz to 2 MHz with an external oscillator signal for output to a spectrum analyzer. It also has a 3 MHz signal source that may be applied to the spectrum analyzer. We weren't too excited about this unit until we noted the high quality of construction of several nifty RF modules inside. It uses 115 VAC, has a balanced mixer, a ultra-stable VFO (2.985 - 3 MHz) with a beautifully clean sine-wave output, 600Ω step attenuator, stable -15 VDC power supply, and a 2.5 MHz IF amplifier module. We tested one, and after warmup the VFO drifted only 25 Hz! You could add a crystal oscillator and use the balanced mixer for a QRP Transmitter, or add a detector and modify the VFO for the desired band and have a HF receiver, use as a stable signal generator for HF, or you could add frequency multiplier stages for a stable VHF RF source, etc. Includes power cable, three BNC cables, manual w/ schematic. Unused!

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Option #3 -- Buy both units above, only **\$44.95!** What a deal!

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13097	1000μF 40VDC Axial Aluminum Electrolytic Capacitors, bag/10
13028	Cigarette Lighter Plug with three feet of cord
12843	Romex Staples, white plastic saddle, 1/2", bag/100
12840	Coax Staples, white plastic saddle, perfect for RG58/59, bag/100
13029	TV/Game switch box, "F" conns. for TV input/output, RCA for game
13102	Coax cable, RG59 with "F" connectors, 3 ft. long
230	Coax cable for video games, 75Ω, with RCA connectors, 15 ft.
14048	"Jewel Box" for Compact Disk, empty
13095	3M stick-on feet, 3/4" square, grey, sheet of 24
10593	Texas Instruments 14p. solder tail IC sockets, pack of 50
1190	Texas Instruments 24p. solder tail IC sockets, pack of 15
12511	Heatsink Compound (white silicone paste), 1 Oz. tube

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ON THE COVER: The Detector '700 super-gain microphone amplifier. See article on page 18. Photo shot at Carpinteria State Beach in So. Cal.

EDITORIAL CONTRIBUTIONS

Nuts & Volts Magazine encourages article submissions and queries.

Send a SASE for a copy of our writer's guidelines.

All submissions should be on 5-1/4 or 3-1/2 inch diskettes and include hard copy as well. If return of materials is requested, include a SASE with your submission.

Deadlines should be discussed in advance with the editor but generally all material should be submitted by the 1st of the month for the next month's issue.

COVER PHOTOS

Good quality color transparencies are accepted for cover backgrounds. Landscape type photographs relating to electronics are preferred.

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reader

Feed Back

Dear Nuts & Volts:

Don Lancaster's "Resource Bin" column in the June, 1993, issue, contained a great deal of very helpful information for learning more about ham radio. However, some parts of the article are misleading, and some important new sources of information were omitted.

The number of radio hams is **not** down. In fact, according to FCC statistics, there are more hams in the United States today than ever before—more than 600,000. And the hobby is growing at an excellent pace, thanks mostly to the codeless Technician class license (Mr. Lancaster doesn't even mention that it's possible today to get a ham license without knowing Morse code). This license provides access to most of the activities that he goes on to describe—FM repeaters, computer-to-computer packet radio & on-air packet bulletin boards, amateur TV and round-the-world communication through ham radio satellites.

Technically, Mr. Lancaster is correct in saying that the average age of hams is up. But it doesn't mean that the hobby is no longer attracting young people. One of the fastest-growing groups of new hams today is retirees, people who never got around to becoming hams while working, and who decide to pursue it as a retirement activity. With large numbers of people in their 60s entering the hobby for the first time, the average age of all hams goes up. Plus, the average age of our country's population as a whole is increasing. There are fewer young people overall. Therefore, they will make up a smaller percentage of the overall population.

Mr. Lancaster goes on to say that "repeaters let you talk across the country or around the world from a small and low power hand-held transceiver. Packet Radio is the buzzword here." While some repeaters are linked to HF (short-wave) ham bands to permit long-distance contacts, most are used primarily for local or regional communications, often among people driving in their cars or walking with hand-held transceivers. Most repeaters relay voice communica-

tions. Packet Radio is something completely different. Hams use packet radio to link computers over the air, and to connect with Packet Bulletin Board Systems, which are hooked together in a worldwide network.

Finding a ham or ham club can often be a challenge, but your sheriff's office isn't really the place to turn for help (they generally have more important things to do). Your best bet is to contact the American Radio Relay League (ARRL) at 1-800-32-NEWHAM (they'll send you a list of local clubs, instructors & license exam opportunities) or the National Amateur Radio Assn. (NARA) at 1-800-GOT-2-HAM (they'll also send out a packet of free information).

Mr. Lancaster's list of ham resources is extensive but contains one significant error and does not even mention an entire class of ham radio resources—home videotapes. QST, the ARRL's membership journal, is **not** "a non-commercial venture." While the League itself is not-for-profit, QST is very commercial. Every issue contains hundreds of ads.

Finally, people who want to learn more about ham radio can see and hear the hobby in action through a new library of videos produced by the publishers of CQ and Popular Communications. Ham Radio Horizons: the Video provides a fast-paced, broad-based, introduction to the people and activities that make up today's ham radio. (A companion book, Ham Radio Horizons: the Book, does the same in print.) More specific introductions to certain ham activities are available in Getting Started in Packet Radio, Getting Started in Amateur Satellites, Getting Started in DXing (the search for contacts with far-away places) and Getting Started in Ham Radio, a guide for new hams to setting up their first stations. Each program is about 50 minutes long, and are available for \$19.95 each (+ shipping for mail order) from many ham dealers or directly from CQ Communications at 516-681-2922.

Richard S. Moseson
Executive Producer
CQ Productions

Continued on page 24

HAM GEAR FOR SALE

10

LOW PRICED quality two-way radio Ritrone UHF RP+ w/duplexer, AutoPatch manual \$225. Microwave 6, 12, 18 GHz Fairnon & Mot \$100 up. Mot amplified speaker \$10. CEIRSI recv. \$300. Much more! For current list call/fax 909-873-1319 or write John Lansdell, 424 E. Shamrock, Rialto, CA 92376.

MORSE KEYBOARD from July 1992 QST. SASE for info. SCS, Box 680, New Hartford, CT 06057-0680.

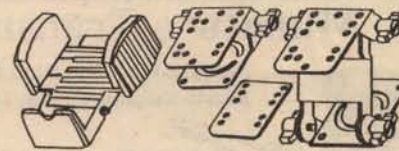
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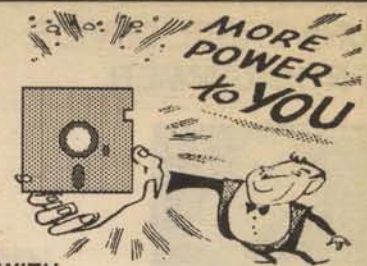
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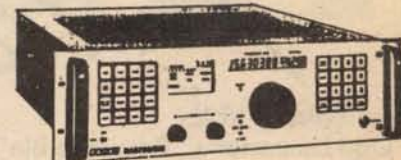
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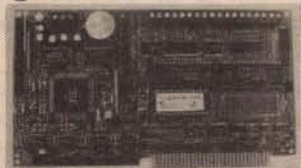
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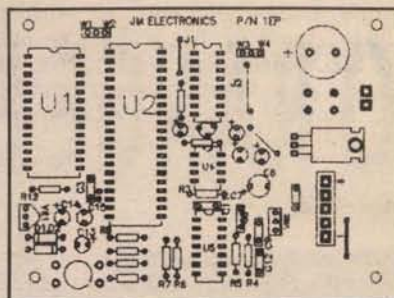
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Gordon
West

When July 5th rolls around, you may always depend on unbelievable VHF and UHF radio range. Mariners talk 300 miles on VHF marine band. Hams talk 400 miles through a distant 2-meter repeater. You watch a TV station for 3 days from another state. Cellular phone coverage extends hundreds of miles to sea. Land mobile UHF radio systems are clobbered with out-of-area co-channel interference.

If you are a radio enthusiast, you have probably experienced these summertime VHF and UHF phenomena. And these extra-long-range radio conditions only occur on very high, ultra high, and super high frequencies. And these extra-long-range circuits have absolutely nothing to do with the ionosphere, sunspots, or E-layer refraction.

To better understand the phenomena of radio wave propagation at extremely short wave lengths, I want you to recall what you saw when you last went for a trip out to the desert or along a stretch of open highway on a hot summer day. Remember? As you looked down the roadway, or out on the desert floor, you saw a shimmering blue, mirror-like reflection of the sky. The longer you stared at this mirage, the more you could understand its behavior. It only occurs on extremely hot days when there is little wind. A sharp boundary of extremely hot air causes you to see a reflection of anything above it. If it's a clear day, you see the blue sky as if you were looking at a dry lake bed full of water.

The mirage you are looking at causes images above it to refract (not reflect) the image back to the observer. Unlike a reflection, this hot air refraction phenomena requires you to be standing at just the right spot in order to see down to an object that is really above where you are looking at.

This same phenomena may occur in reverse, too, and this is what we will explain that causes extra-long VHF and UHF communications and distant-TV signal reception. The above-us mechanism is technically called a tropospheric duct. The tropo duct is created when a summertime static high-pressure cell builds up so strong that air within it becomes heavy, and drops.

This is called subsidence. When this descending air gets to around 1,000 feet, it bottoms out and becomes compressed with additional descending air. When you compress air, it gets warm. This warm air "mirror" forms above us for several hundred and sometimes thousand miles, and it is squashed between cool air below and cold air above. If the temperature inversion is greater than 8 degrees, and if the tropospheric duct is no more than 300 feet thick, an inverted radio mirage forms, and VHF and UHF and microwave signals are refracted along its path for hundreds of miles.

During periods of "stagnant" local weather conditions, the tropospheric duct appears as a band of smoke hanging above the horizon. During intense periods of tropospheric ducting, this hot air inversion may become so pronounced that optical refraction occurs out on the horizon. In Southern California, beach-goers were treated to a view of some island peaks in Mexico over 250 miles away, well beyond the line-of-sight view, with the islands hanging upside down, suspended by this reverse optical mirage. The condition lasted for almost 2 hours before the local winds came up and blew away this once-in-a-lifetime phenomena.

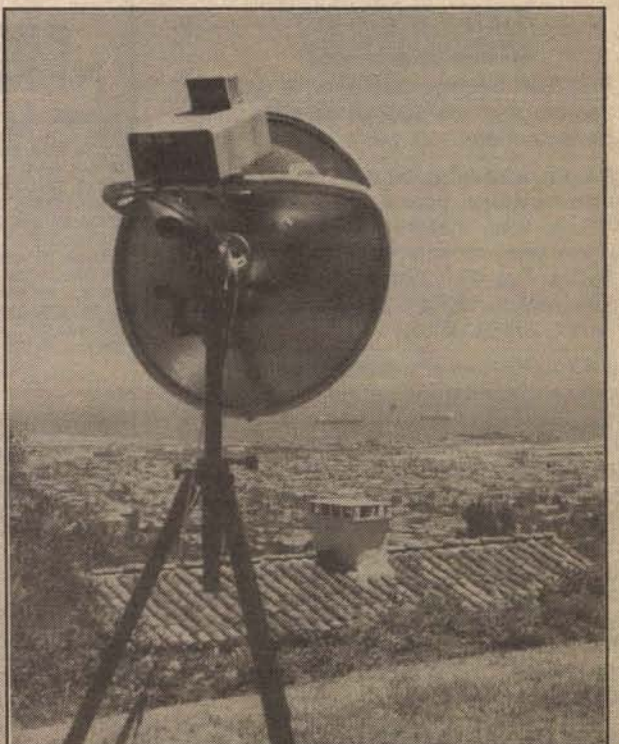
July and August are the principle months of tropospheric ducting throughout the United States. The longest over-water path is between California and Hawaii. Amateur radio operators have successfully communicated via tropospheric ducting on the following frequencies for hours at a time:

50.100 MHz
144.170 MHz
222.1 MHz
432.1 MHz
1296.0 MHz
2304 MHz
5 GHz
10 GHz - not yet

Summertime tropospheric ducting within the United States may regularly occur between the Great Lakes and Texas. There is a very common tropospheric duct that

occurs between Texas and Florida. And down at Key West, they may pick up VHF and UHF radio traffic as far north as Maine when a high pressure cell sits over the East Coast.

Your first clue to the creation of a new tropospheric duct is a high pressure system coming into play with your local weather conditions. The weatherman may complain of hot muggy weather for the next few days, and where he or she draws the high pressure circle on the weather map is where you might likely find a tropospheric duct path. The path usually occurs from one



▲ Tropo ducting will carry 10 GHz signals over hundreds of miles.

edge of the high pressure system to the other edge.

Another clue to the tropo duct forming up is local weather conditions where distinct bands of smog and smoke can be seen hanging on the horizon. If it's a hot, windless day, get set for some action.

If you have a weather facsimile program that may tune in high frequency broadcasts from the Navy and government, then by all means tune in! Here are the best frequencies to tune to for clues to tropospheric ducting from their well-prepared weather maps:

8680.1 kHz - Pacific Coast
23,329.4 kHz - Continental U.S.
9155.6 kHz - Gulf of Mexico
10,863.1 kHz - Atlantic Coast

If you have a shortwave receiver, a ham set with a general coverage receiver, or a portable shortwave set capable of upper sideband, you can easily tune in these broadcasts with a nothing-antenna system. They boom in. A \$99 program is available that connects between your computer and your receiver to decode up to 17 shades of gray on your laptop or PC compatible computer. The best software system is available from SS Consulting (714/498-5784). For \$99, just tell them the type of computer you have, and the type of receiver you have, and they'll send you the works.

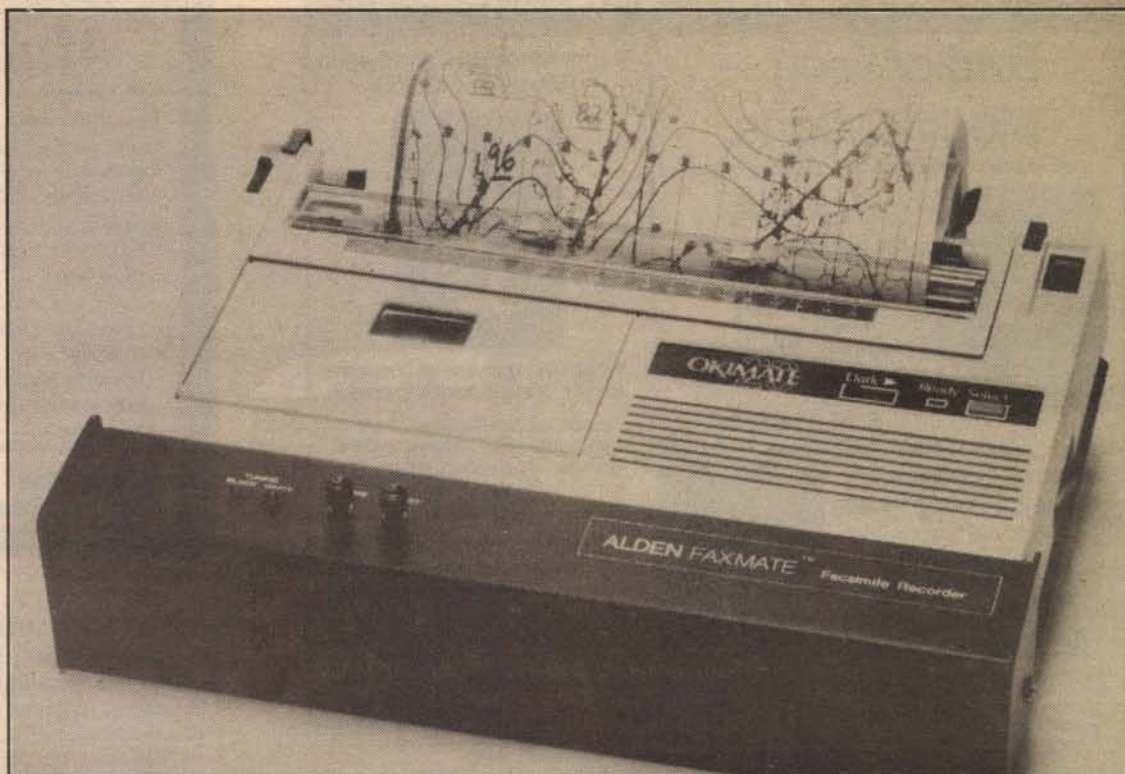
Tropospheric ducting to mariners using marine VHF channels is a novelty. Many times you'll hear boaters talking back and forth on 156.300 MHz over distances greater than 300 miles — all with a little 25-watt power level! And for cellular telephone users, when tropospheric ducting occurs, they many times will hear the dial tone in areas that have had absolutely zero cellular phone coverage before. Another bonus!

For TV viewers on an outside antenna, it's fun to pick up TV stations on VHF Channels 2 through 13, and UHF Channels 14 through 50, hundreds of miles away. It won't work on cable — but if you have an outside TV antenna, get set for some summertime special viewing.

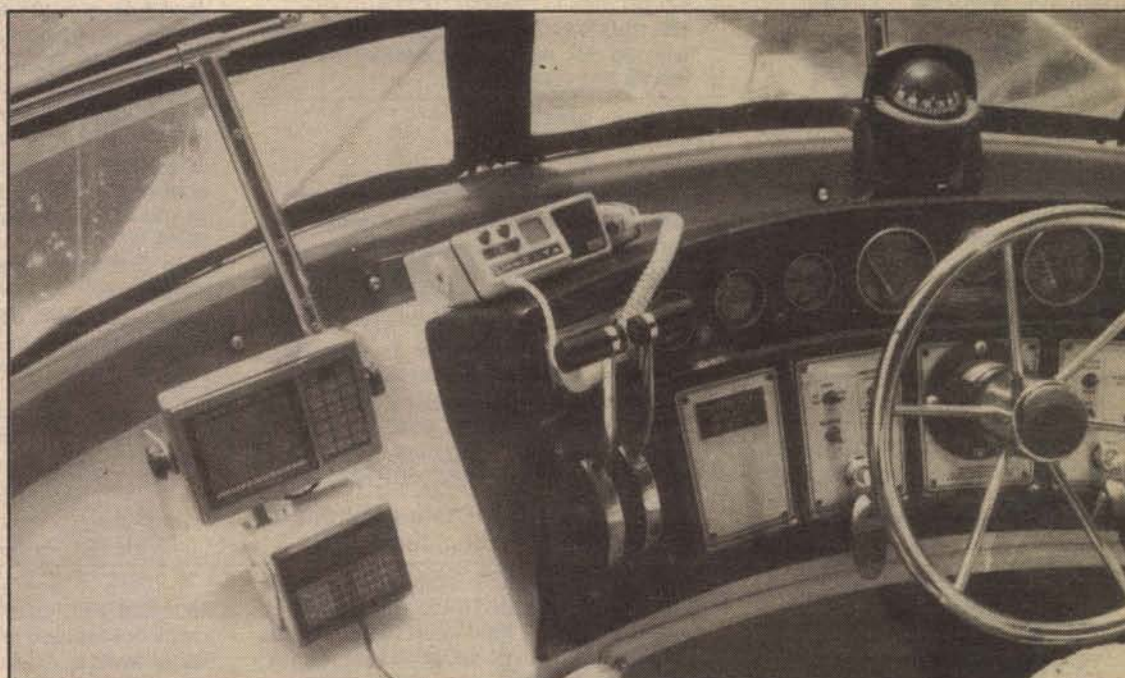
For commercial radio users, tropospheric ducting is a pain in the ear. The local ambulance company might start receiving UHF radio signals from another emergency squad 500 miles away. As long as the weather conditions remain stable, the interference will not quit. During periods of heavy tropospheric ducting, the long-range signals will stay in both day and night. Remember, tropo ducting has nothing to do with Sporadic-E or ionospheric conditions.

For those of you who are airplane pilots, you might find yourself talking to an airport over 1,000 miles away. You will also find that specific altitudes will put you right inside the "tropo" tube, dramatically enhancing your aeronautical communications range. In fact, this is how scanner buffs tell when a tropospheric duct is occurring — they listen for aeronautical omni stations coming in hundreds of miles away that they would normally not ever hear.

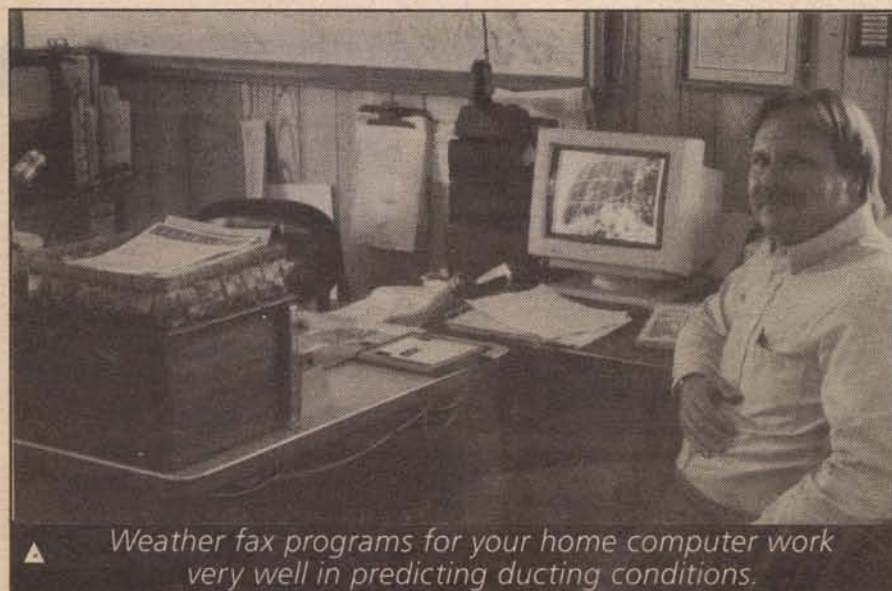
So this summer, get set for some fireworks out on the airwaves. If the high pressure weather conditions prevail, you are going to be hearing and seeing some signals that you never thought could travel so far. It's an every-year occurrence, and it's just beginning to start RIGHT NOW. NV



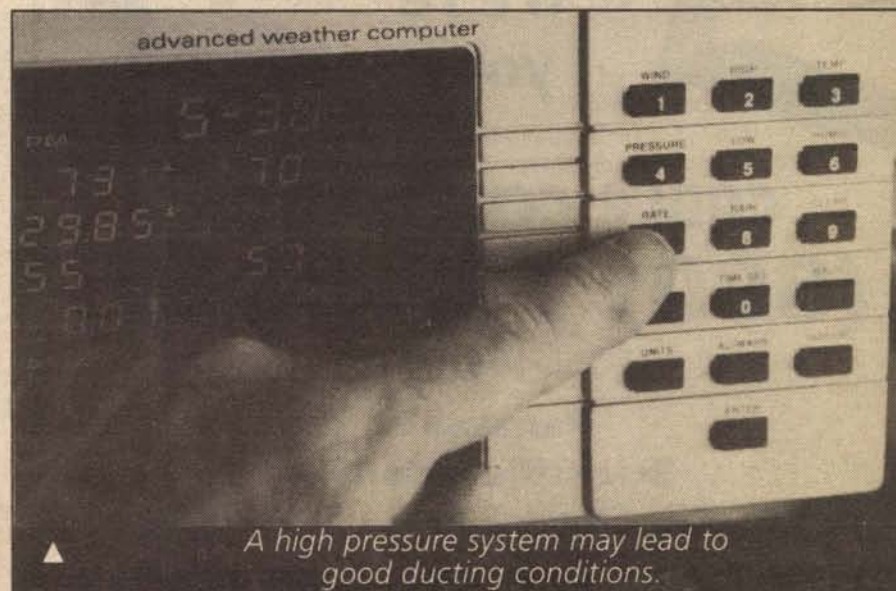
▲ A weather fax recorder is a good way to spot tropo ducting conditions.



▲ Signal ducting occurs on marine VHF, too.



▲ Weather fax programs for your home computer work very well in predicting ducting conditions.



▲ A high pressure system may lead to good ducting conditions.

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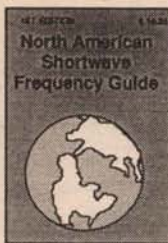
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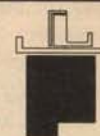
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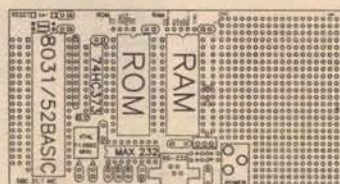


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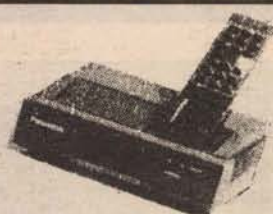
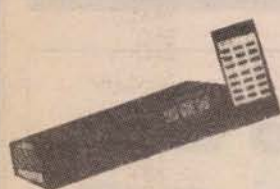
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MINIATURE SPEAKER

This 1" speaker is an ideal companion for installation in our boom mike featured above. (92A002) **\$1.49**

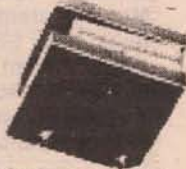
STEREO EARPHONES

Unit impedance 32Ω ±1.5%; 27mm mylar speakers with washable ear sponge; max. power 0.05W; 4-foot cord; compatible with all personal stereo products. (93V002) **\$3.95**



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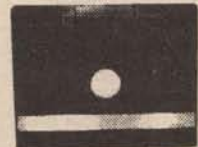
ATARI 2600 TRACKBALL

Also works with C-64 and C-128 computers. Smooth ball bearing action. Cable with DB9 connector included. (Dealer pricing available.) (92C069) **\$9.95 each**



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Use as-is or dismantle for a treasure trove of goodies such as: HEAVY snooker ball; 5 ball bearings; 2 optical encoder wheels. ICs are CD4011, CD4013, CD4030, CD4538 and CA339. Also 34 resistors, caps, 3 diodes and one transistor. New, unused. (92C068) **\$12.95**



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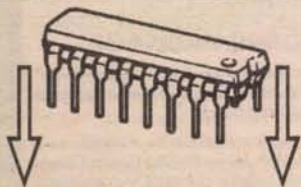
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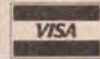
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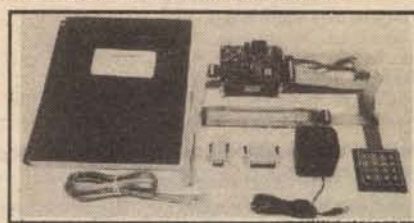
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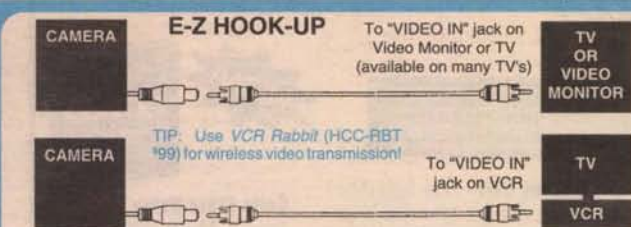
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Manufactured by Linear, this low cost RF link is ideal for wireless control of your own projects, your home and car alarm, electric car doorlocks, and even X-10 modules (with addition of HCC-284 Powerflash Module - see desc. this page)! Set security code on transmitter and receiver, apply power to receiver board, and you're ready for wireless control!

RECEIVER: Board level receiver measures approx 3" square! Requires power supply of 8 to 24 VDC or 12 to 18 VAC. Two outputs (channels 1 and 2) can each switch up to 300 mA @ 18 VDC maximum to ground. Directly activate relays, drive bulbs, more.

HCC-RF1 Set includes transmitter, receiver, documentation. **ONLY \$39!**
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Great for development of your own infrared home control system! Requires One-For-All remote control (see opposite page). Remote has special port which connects to your PC's serial port (using our cable and hardware interface). Use the SendIR program to transmit infrared signals by "pushing buttons" on the remote control. For example type the dos command **SendIR TV MUTE** to mute the tv; or **SendIR VCR REC** to start your VCR recording! Call SendIR from DOS batch files, your existing software program, or develop a program from scratch using sample source code.

PC based home automation for infrared control of your TV (volume, channel, etc), stereo, VCR, and more! Add whole-house IR repeater such as X-10's Powermid (desc. top of pg.). Use with Covox Voice Master Key (HCC-VMK1 \$169) for voice control of your entertainment system! Combine with X-10 Development Kit (right) to allow any X-10 controller to control your infrared devices! Use with voice mail system for remote control of IR from any telephone. Possibilities are limitless!

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Use to develop your own PC-based "smart" home automation system! Monitor status of home's lights & appliances and make intelligent decisions based on their on/off status. Develop a home control system with IF-THEN logic, even 1-button macros! Add Stanley motion detectors to give system input of room presence. Development software is interrupt based (does not use polling!) and includes compiled library routines and sample C-language source code.

Use with PC to Infrared Interface (left) to develop a system combining home automation and IR control; any X-10 controller can control infrared! For voice control of the home add Voice Master Key (HCC-VMK1 \$169). Give your system dusk/dawn input with Sundowner (HCC-533 \$159). Add voice PC mail card for remote call-in control of X10! Requires IBMPC or compatible computer with parallel port and C-language compiler (Microsoft or Borland). Includes TW523 module, adapter, interface cable, development software, demo program and technical info/data. HCC-523K **ONLY \$69!**

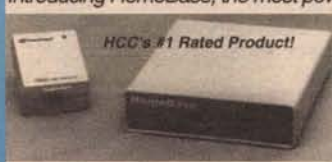
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Introducing HomeBase, the most powerful mid-end (under \$10,000) home automation system on the market!



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Intelligent Controller Integrates X-10 and Infrared Technology!

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- Monitors your powerline and allows IF-THEN control. Complete 2-way X-10 system!
- Uses PC to set your home's schedule... once programmed your PC may be powered down or used for other things
- User-friendly windows-like interface
- Can even be used with a mouse
- Real-time clock/calendar keeps track of sunrise/sunset
- Battery backup
- No language to learn
- Mega-Controller allows on-line control... It's an on-screen X-10 controller and a status display of your home

HomeBase's expansion port allows easy integration with add-on products to expand and enhance your home automation system!

Infrared Interface

The Infrared Interface integrates HomeBase with your home's infrared-controlled devices! Smart remote with modified electronics & cable plugs directly into HomeBase! Use with Powermid (see top of page). Allows HomeBase to control IR functions such as TV volume & channel, CD player track & song select, stereo system speakers on/off, VCR play or record & much more! HCC-3005 **ONLY \$149**

I/O Interface

The I/O Interface integrates HomeBase with security systems, moisture sensors, temperature input, motion detectors, motors, virtually anything that X-10 can't! Features opto-isolated inputs and relay outputs. Available 4th Quarter 1993. HCC-3008

Remote Communications Upgrade

Remotely control your home from any computer anywhere in the world! (Requires PC w/modem and 2400baud modem for HomeBase) Dealer/Installers, change your client's schedule or debug their system from your office! Allows you to offer a service contract with your home automation package! HCC-3003 **ONLY \$99**

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"Surprisingly easy to use yet extremely powerful!"
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HCC-3001 HomeBase **ONLY \$299**

FREE Remote Communications Upgrade (\$99 Value) to first 125 HomeBase orders!

HOME CONTROL CONCEPTS

COOL SUMMER HOME AUTOMATION SPECIALS

Keychain Remote & Base
New! Complete system including 2 channel keychain remote control and base transceiver. Black 2 button keychain switch selectable to send ON & OFF for X10 unit numbers 1 & 2 or 5 & 6. Base transceiver receives all 16 unit numbers on a housecode, & has built-in lamp module! Upto 100' range. HCC-6500 **ONLY \$29.95**
HCC-674 Keychain Remote (w/o base) \$16.95

Wireless Wall Switch
New! Attaches to wall with velcro... no wiring required! Sends RF signal up to 100' to base transceiver (keychain base, see above; HCC-501X base; or X10 security system base, see below). 4 button unit can control X10 unit numbers 1-4, 5-8, 9-12 or 13-16. HCC-694 controls four X10 devices; HCC-724 controls three plus DIM/BRIGHT; HCC-684 controls 2 X10 devices **ONLY \$16.95**

RainMatic RainSensor
Automatic moisture-sensing switch stakes into ground, sends signal to water timer (right). Trigger X-10 PowerFlash (see desc.) to signal HomeBase (next pg)! Adjustable moisture setting. HCC-RMRS **ONLY \$32.95**

"Understanding & Installing Home Systems: How to Automate Your Home" by David Gaddis
Home Automation Book
New Edition, expanded and improved! *Electronic House* magazine says "...really works. ...Gaddis has done a great job..." Also reviews in *Popular Science*, *Radio Electronics*, and *Circuit Cellar*. Excellent! Topics include Security, Lights, Appliances, Entertainment, Communications, Energy Management, Heat & Air, Pools & Spas, Home Theatre, and more! 150 pages & over 125 illustrations. Recommended! Reg. \$29.95 HCC-BOOK1 **ONLY \$26.95**

MobileControl
Stanley 8-button hand-held remote done in sleek 1990's styling. Transmits RF signal up to 100 ft. to plug-in base transceiver. Off-white color. HCC-2553 Mobile Control & Base **ONLY \$14.95**
HCC-2553 Mobile Control & Base **ONLY \$33.95**

New! Security System with Voice Dialer
Supervised system (like HCC-S8000, see below) with built-in dialer! Has same features as HCC-S8000 listed below (without infrared interface). When tripped, sounds loud 95 dB alarm and dials up to 4 phone numbers and gives 15 sec. of voice message (in your voice) to a friend who can then "listen in" to your home over the phone to determine the nature of the problem. Expand your system anytime by adding door/window sensors, motion detectors, or a plug-in Powerhorn siren (below). Includes remote control for arm/disarm with or without entry/exit delay, and control of four X10 modules. HCC-S8800 **ONLY \$97.50**

New! Supervised Wireless Security System
Installs in minutes - with no tools - and no wiring! URC8000 Console keeps track of 16 zones and displays status of each using LEDs. Because it's supervised you'll know if any door/window sensor is not working or has low battery. Add wireless door/window sensors to protect up to 16 different groups of doors and/or windows. Add a motion detector to protect an area with more than one entry point. Console sounds loud 85 dB alarm and sends X-10 signals to flash all X-10 lights! Scare intruder and makes home visible to others (neighbors, police enroute, etc.).
Built-in infrared command center (see HCC-3000, right) for use with One-For-All remote! Console is also a receiver for the Stanley hand-held Mobile Control and the X-10 hand-held remote for controlling sixteen X-10 devices!
Expand your system anytime by adding door/window sensors, motion detectors, or a plug-in Powerhorn siren!
HCC-S8000 Security Console **ONLY \$59.95**
HCC-574 Keychain arm/disarm **ONLY \$19.95**
HCC-534 Door/window Sensor **ONLY \$14.95**
HCC-554 Wireless Motion Detector **ONLY \$49.95**

Keychain Arm/Disarm Controller
Get an Arm/Disarm Controller for your X10 security system at a RED HOT price when you order an HCC-S8000 Security Console (see above) and One-For-All remote control (see right). \$21.95 Value. Limit 1. HCC-574X **ONLY \$9.99** WITH PURCHASE OF HCC-8000 & HCC-RC5

Electric Door Strike
Industry Standard "No. 220" electric strike is activated by 8-16V AC or by 3-6V DC. May be used with doorbell type transformer.
X-10 compatible when switched with Universal Module (see right)! 1991
HCC-2006 **ONLY \$39**

X-10 Hackers Bible
The world's greatest collection of beginner, intermediate and advanced home automation Tips, Tricks and Applications! Whether you're a casual addict or a bona-fide home automation nut, you'll love this publication!
HCC-BHB1 Hackers Bible/Book I **ONLY \$19.95**
HCC-BHB2 Hackers Bible/Book II **ONLY \$19.95**
HCC-BHB3 Hackers Bible Collection/Books I&II **ONLY \$29.95**

RainMatic 3000 Water Timer
Automatically switches water on/off up to 8 times per day, 1 to 7 days a week. 14-day sched. capability permits alternate day watering. Can skip selected days. LCD display, manual override, automatic misting, more!
HCC-RM3000 **ONLY \$39.95**

Heath Zenith Motion Switch
Senses motion and turns on light. Adjustable delay shut off. Great for hallways, basements, garages, laundry rooms, bathrooms, more. Photocell adjusts for night-only operation. Heath/Zenith Quality. Saves Energy. HCC-6105 **ONLY \$14.95**
HCC-6107 For 3-way switch applications \$19.95

3-Prong Appliance Module
Plug-in appliance module rated 15A resistive, 500W lamps, 1/3HP motors. Off-white. By Stanley. HCC-2550 **ONLY \$9.99**

Stanley Home Control
Turns on/off up to eight X10 lights and appliances. Has illuminated ALL LIGHTS ON button. Also has DIM/BRIGHTEN and ALL UNITS OFF buttons. Off-white color. HCC-2551 **ONLY \$8.99**

Heath/Zenith Chime
Works with X-10! Just set house and unit code and plug in. Use with Stanley motion detector (desc. this pg.) to announce guests and intruders. Signal someone in another room with any X-10 controller. Use with PowerFlash module (desc. below) to extend your existing doorbell system. Pleasant chime goes "ding-dong ding-dong ding." HCC-CH1 **ONLY \$18.99**

Powerhorn Remote 110 DB Siren
For use with Supervised Security Systems (above). Can also be triggered by the PowerFlash module (see right) or any X-10 "On-Off-On" sequence. Off-white. By Schlage. Reg. \$39.95 HCC-508X **ONLY \$24.90** FOR 2 OR MORE; SINGLE \$29.95

Universal Wall Switch Module
Replaces existing wall switch. Controls incandescent lights up to 500 Watt max. Ivory color button. Only 840 modules reserved for this promo, so order now! By Stanley. Limit 48. HCC-2475 **ONLY \$9.99**
HCC-2476 3-Way Switch Set (pair) **ONLY \$19.99**

Stanley Premier Home Control
Same features as Home Control (desc. this page); controls 16 devices. Handsome simulated woodgrain design with smoked flip-up keyboard, dust cover. HCC-2549 **ONLY \$17.49**

X10 Computer Interface
White box connects to PC's serial port; once programmed PC may be shut off or used for other purposes. Schedule up to 256 devices (IBM & Mac versions), 72 devices on Apple IIe/IIc. Commodore. Battery backup. Console, software, cable, manual. **ONLY \$59.95**
HCC-290P (IBM Version); HCC-290M (Mac Version); HCC-290C (Commodore Version); HCC-290A (Apple IIe/IIc Version)

Heath Zenith Motion Switch
Senses motion and turns on light. Adjustable delay shut off. Great for hallways, basements, garages, laundry rooms, bathrooms, more. Photocell adjusts for night-only operation. Heath/Zenith Quality. Saves Energy. HCC-6105 **ONLY \$14.95**
HCC-6107 For 3-way switch applications \$19.95

Panasonic 12V Power Adaptor
Hot item, hot price! It's 12 VDC @ 500 mA, it's white, it's a great buy, and it's Panasonic! Use 'em for everything! At this low price buy extras for future projects... Stock up on these plug-in power adaptors while they last! HCC-PA12V **ONLY \$4.99** Dealers, Limit 200
Buy 6, get 1 free! Order HCC-PA12Vx

Professional Motion Detector
This Passive Infrared (PIR) Motion Detector is used for professional high-end security systems and measures only 3.71" x 3.71" x 2.18"! Wall, Corner and Ceiling to Wall mountable. Walk Test LED; N.C.: 2 to 5 pulse count (selectable); tamper contacts. Includes 40' x 40' and 70' x 7' lenses and instructions. Requires 10.7 - 18 VDC (works with HCC-PA12V power adaptor, above). Use for Security and/or Automation systems (see PowerFlash Interface, below). By Linear, the Mercedes of security components! HCC-PIR **ONLY \$39.90** UNBELIEVABLE LOW PRICE! NORMALLY EXPECT TO PAY \$60!

PowerFlash Interface
Plug-in module is activated by a 6-18V low voltage input or a dry contact switch. Output mode can be set to several types; use to turn on any X-10 module, turn on all lights for an entire housecode, or send ALL LIGHTS FLASHING (this will also activate PowerHorn Remote Siren, left).
Wire to output of your existing home security system to flash your X10 lights. Use with external switch (e.g. doorbell switch, motion detector, etc) to activate an X-10 chime (above left) or beeper (see Universal Module desc. this pg.).
Use with HCC-PIR Professional Motion Detector (above) to alert HomeBase (next page) of room presence... have music or mood lighting follow you from room to room... turns HomeBase into a smart security and automation system! Your interface between X10 and the outside world. By Schlage. HCC-284x **ONLY \$14.99** Reg. \$19.95 LIMIT 24

Universal Module & Beeper
This plug-in module is activated by an X10 command and has a relay output with screw terminals for control of electric door strikes (see left), sprinkler systems, garage door openers, arm/disarm security systems, etc.
Built-in beeper may be used for setting up X-10 based paging system, alerting you of motion outside (see Motion Detector & Floods, this pg.), etc. Output may be set to "Relay," "Beeper" or "Relay+Beeper." Also may be set to "Momentary" or "Continuous" HCC-506 **ONLY \$19.95**

Stanley Power Timer
Programmable timer can schedule 4 lights & appliances up to twice a day. Manual control of 8 devices. Security feature for random on/off times. Delay feature turns off selected devices at a later time... great for late night TV viewing! Clock with alarm and snooze feature. Illuminated ALL LIGHTS ON button. Battery backup. HCC-2552 **ONLY \$24.95**

Hacker's Bonus
We'll give you a copy of SENDX10 shareware computer software with your purchase of HCC-290 (left). Let's you send X10 commands from DOS! Order number HCC-SHW

Thermostat Setback for X10
Saves you money all year long! Mounts below your existing thermostat and supplies a small amount of heat below your thermostat when turned on. This fools your thermostat to turn on or off the heat or air. Plugs into any X10 appliance module. In winter set back your thermostat 5, 10 or 15 degrees while you're asleep or away. During the summer you can cool down your home 30 minutes before you come home. HCC-2807x **ONLY \$9.95**

Motion Detector & Floods
Detects motion, turns on floodlights, and sends up to four X-10 ON signals to modules located inside or outside the house. OFF delay (10 sec. to 35 min.), dusk/dawn & sensitivity adjustments. Detects motion 40 ft. at 110° arc. Floods can also be turned on with any X-10 controller. Weatherproof. Bulbs not incl. HCC-2651 **ONLY \$39.99**

Power Strip for X10!
This power strip holds four X10 modules (most hold only two)! The 7 outlets on this special powerstrip are perpendicularly orientated, meaning X10 modules hang off the sides of the strip, not along the strip! HCC-XPS **ONLY \$9.99**

One-For-All 12 Lets You Control X10 and Infrared from one remote!
Billed as the most powerful universal remote in the world, the One-For-All 12 replaces 12 of your existing remotes for TVs, VCRs, Cable Boxes, CDs, Audio Products, Satellite Receivers and more! It can even control X10 modules!
The One-For-All 12 has a 32K memory which contains the world's largest library of infrared codes! In fact, the manufacturer is so confident that your component's infrared codes are contained in the One-For-All 12's memory that they're offering a DOUBLE YOUR MONEY BACK GUARANTEE! (call HCC Customer Service or Universal Electronics for further details)
More great features: Provides any device with a Sleep Timer function * Simple set-up * One Button System Control * Perfect replacement for lost or broken remotes * Toll-Free Consumer Help Line * Lifetime upgradable (by manufacturer, no charge!) to match the latest advancements in IR remote control technology... won't become obsolete!
X10 Compatible! Combine with the HCC-3000 One-For-All Command Center for control of your home entertainment devices AND X10 devices! Just aim the remote at the HCC-3000 for instant control of your home's lights and appliances!
Attention PC hackers! The One-For-All 12 is even PC compatible with the addition of the HCC-PCIR PC to Infrared Interface! (description next page)
One-For-All 12 Universal Remote Control HCC-RC5 **ONLY \$77.90!**
One-For-All Infrared Command Center HCC-3000 **ONLY \$29.95!**

Lamp Module 6-Pack
Plug-in lamp module controls incandescent lights up to 350 Watt max. Off-white color. Module is labeled "Emergency HouseLighter Lamp Module." Manufactured by X10, private label by Schlage. HCC-1220X **ONLY \$35.90**

Professional Quality Designer Components
Wall Switch Use to control fluorescent or incandescent lighting, appliances, motors, etc. Rated 20A. Neutral required. HCC-8001 White; HCC-8000 Ivory
Ceiling Fan / Low Voltage Dimming Switch Module Dims low voltage lighting & controls motor speed (e.g. ceiling fans) using X10 DIM/BRIGHT! Rated 500W incandescent, 500VA inductive. HCC-8041 White; HCC-8040 Ivory **YOUR CHOICE ONLY \$39.90**

Useful Plans
HCC-PLN1 Add local dimming (from the switch itself) to your X-10 Wall Switch! Push on / push off; or hold in button (min. 2 secs.) for dim / bright. Capability is already designed into the switch (for Leviton's specs)! Simple modification... just add a jumper wire! Also works for Stanley & Tandy switches; 3-way switches too! Detailed instructions for beginner hacker. For informational purposes only. Complete plans \$6.
HCC-PLN2 Control your Hi-Fi's volume with X-10 dim/bright buttons! Detailed instructions for beginner to intermediate hacker. For informational purposes only. Complete plans \$6.
HCC-PLN3 Cable television secrets; watching pay channels. For informational purposes only. \$9.
HCC-PLN4 Two different plans! #1: Modify X-10 modules for momentary on or off from any controller. #2: Modify mini-controllers for momentary on or off control of any module; just add a jumper wire! Detailed instructions for beginner hacker. For informational purposes only. Complete plans \$6.

Wireless Data Link
Use for wireless data transmission up to 2K Bps! Great for all kinds of projects! If desired, add your own encoding/decoding. Tiny transmitter has pin connector for power and modulated data. Shielded super-regenerative type receiver with exceptional -98 dBm sensitivity and surface mount technology!
Receiver requires SVDC regulated (low power mode) or 8-30 VDC unregulated. Add 9' wire antenna for up to 150 ft. range; wire to F-connector and add whip antenna (HCC-4318 3-ft. Antenna \$29.95) for greater range! 303.875 Mhz. HCC-WDL **ONLY \$49.95**

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DETECTOR '700

by Anthony Charlton

Have you ever wished for a device to greatly increase the hearing power of the human ear? Perhaps you are a Nature lover who likes to listen to birds chirp and insects buzz about. Or maybe you're a mechanic who's searching for a way to better diagnose what's wrong with engines by listening to them. Perhaps your job is more serious like finding dangerous leaks in gas pipelines. Regardless of whether you want to use a microphone for fun, profit or safety we have an inexpensive and powerful circuit here that you can build for only \$15. In the process you'll learn about high-gain amplifier circuits, automatic level control, a few of the joys and a couple of the headaches the author experienced while designing this project.

CIRCUIT DESCRIPTION

The Detector '700 uses an Electret Condensor Microphone (ECM) cartridge as its sound sensor. (Please refer to Figure 1.) This particular ECM has a frequency response of 20 to 12,000 Hz which fits in nicely with human hearing range. The lower end of this spectrum is necessarily de-emphasized. Since the amplification factor is so great (with voltage gain of 47,000 times), energetic sound waves at low frequencies tend to "swamp" out the amplifier. For example: I was surprised to discover vibrations from passing vehicles and people walking on a wooden floor swamped the quiet sounds I was attempting to hear. So a simple *high pass filter* consisting of low-value electrolytic capacitors was devised. Since these are used in series with the microphone and the amplifier stages, their property called *capacitive reactance* allows higher frequencies to easily pass through. Lower pitch sounds are impeded or blocked altogether.

Returning to the ECM, the type used has a tiny built-in Field Effect Transistor (FET) which pre-amplifies the signal from the ECM element, and also lowers the output resistance from the ECM. Thankfully, that resistance is adjusted to a level suitable for connecting directly to a high-gain circuit without having to contend with impedance-matching techniques. Resistor R1 provides the needed current, which is called *Bias*, to the FET. Another good property of the ECM is its high *signal-to-noise ratio*. This means there is relatively little internal noise generated, so that the amplifier will hear more of the sound we want to amplify and less component-generated static. By carefully observing the output of the circuit on an oscilloscope whose gain is turned way up, you can see this internal noise as a line of random-frequency fuzz with occasional spikes appearing from nowhere. It sounds like a faint "hiss." The hiss is called *white noise* and the spikes are *popcorn noise* so named for their audible resemblance to popping corn. Fortunately, the noise level is small, and even a soft whisper emerges from and overcomes it readily. Note on the schematic capacitors C1, C6, C8 and C10. These are required for two reasons: #1 is to prevent unwanted oscillations from starting up — a plague of all high-gain amplifier circuits (as a fellow once said sarcastically: "If you want an oscillator, build an amplifier!"). The #2 reason is to shunt ultrasonic energy — which we can't hear anyway — to ground, so it won't swamp out what we can hear.

A special IC was chosen to do the amplification. The LM387N Low Noise Dual Preamplifier gives a combination of low internal noise and high gain, low cost, easy availability, and will run off one 9V battery. As its name implies, it's a dual amplifier in a single 8-pin case which makes the job of attaching an Automatic Level Control (ALC) circuit much easier. Thus, we can use one amp in this chip to form the ALC, and the other as a high-gain mike amp.

The first stage of the LM387N is used as an inverting low-distortion amplifier. Its voltage gain is set by the ratio of resistors R3/R2 and as shown is 47,000. Now that's amplification! In some cases, it can be too much. But we trim loud signals to a comfortable level with the ALC next described. Also note metal film resistors are used for R1 and R2 since they generate less internal noise. I suggest using a metal-film resistor for R3 if

you can find one of that high a value (4.7 Meg-Ohms) but I couldn't so I had to settle for a carbon-film type, which still works fine.

Stage 2 is what keeps loud noises from blowing your ears clean off! It's easy to understand if you think of how germanium diode D1 works. Let's say the output from Stage 1 is on the order of 0.3 volts as you are listening to something. Stage 2 normally has a voltage amplification factor of 1, which of course, is related to the ratio R6/R4. So at the 0.3 volt level and less, Stage 2 just inverts the signal and passes it on to Stage 3. Stage 2 also "buffers" the output from Stage 1; isolating it to prevent annoying problems of oscillation. But along comes a high-level sound. As soon as the output from Stage 1 (and hence Stage 2) exceeds 0.3 volts, germanium diode D1 which has previously been inactive, begins to conduct. As it does, the signal is fed back to the amp's input thru resistor R5. The louder the sound, the more signal will be fed back. Ultimately, the pair D1/R5 acts to instantaneously (well, not *instantaneously*, but in say, 10 millionths of a second) reduce the gain of Stage 2 from 1 to 1/15th. So no matter how loud the signal, it can not get bigger than 0.3 volts. This is a level that still is a little loud, but it won't hurt your ears. Silicon diodes like 1N4148 may be used for D1, but they will let louder sounds through before beginning to conduct due to their higher conduction voltage of about 0.6 volt vs. 0.3 volt for germanium. Finally, the large electrolytic capacitor C9 is used to filter the power supply. Without that large a value, the LM387N will break into a "shutdown" oscillation every time it hears a loud sound, and so the circuit goes dead for a second or two. I can't explain this, but it is an idiosyncrasy of the LM387N that manifests in this circuit.

Stage 3 is a common-collector transistor amplifier. Its purpose is to provide enough current for the low-impedance headphones that are attached. In this circuit, Q1 current-amplifies with as little distortion as possible. Resistors R8 and R9 bias the transistor properly for this effect. Like with the other electrolytic capacitors used in the amp portion of the circuit, C7 is a fairly small value so it preferentially passes higher frequency sounds.

BUILDING THE CIRCUIT

It is suggested you follow the parts layout given in our miniature PC board pattern. A component placement guide is

given too. One thing you must not do is try and breadboard this circuit! Its gain is so high that oscillation will undoubtedly develop which will frustrate you. Note the thick traces on the sides of the CAD layout. They function as a "ground plane" to further reduce oscillation possibility, so you can see oscillation is important to avoid, yes?

Follow the recommended assembly procedure for best results. Since this circuit is rather small, try and obtain "miniature" components (which the hole spacing is calculated for), especially the electrolytic capacitors. Capacitors should be of fairly tight tolerance. $\pm 20\%$ is suggested. (See "Parts List".) Since space is tight, you may have to "dry-fit" the components before soldering them in place so they will go together. Remember to observe proper polarity with the diode, IC and electrolytic capacitors. Pin #1 of IC 1 is uppermost right on the foil pattern, and uppermost left on the component placement diagram. It is further identified by the square-looking pad on both diagrams. This IC also has a dot on its case where pin #1 is. The ECM has a green paint dye on its ground side. If that's missing, hold the mike pin side up with the two pins at the top. The semicircle with the two notches has the (+) pin and the semicircle with one notch has the ground pin. Keep all component leads short while assembling.

- 1) If needed, clean the PC board with a fine grade of steel wool, and remove all wool flakes by brushing or blowing off. Note the board will have to be tapped on a table to get the wool out of some of the holes.
- 2) Install the IC socket and solder in place.
- 3) Install diode D1 and solder in place.
- 4) Install transistor Q1 and solder in place.
- 5) Install the resistors standing upright, and solder in place.
- 6) Install all capacitors except C9 and solder in place.
- 7) Strip 3/4" of insulation from each end of the shielded cable. Carefully cut the braid as per Figure 2, and prepare each end as shown. Attach the braid to the ground of the circuit board and the ground pin of the ECM. **Caution:** The ECM can be blown out by a static electricity charge. Use a grounded soldering iron and steps to minimize static if warranted. Solder the center conductor of the wire to the PC board and the ECM as shown.
- 8) Attach your headphone jack and plug. Match the jack type to whatever headphone plug you plan to use. It should be wired so that both speaker elements in the headphone are connected to the Detector-700's output in parallel, as

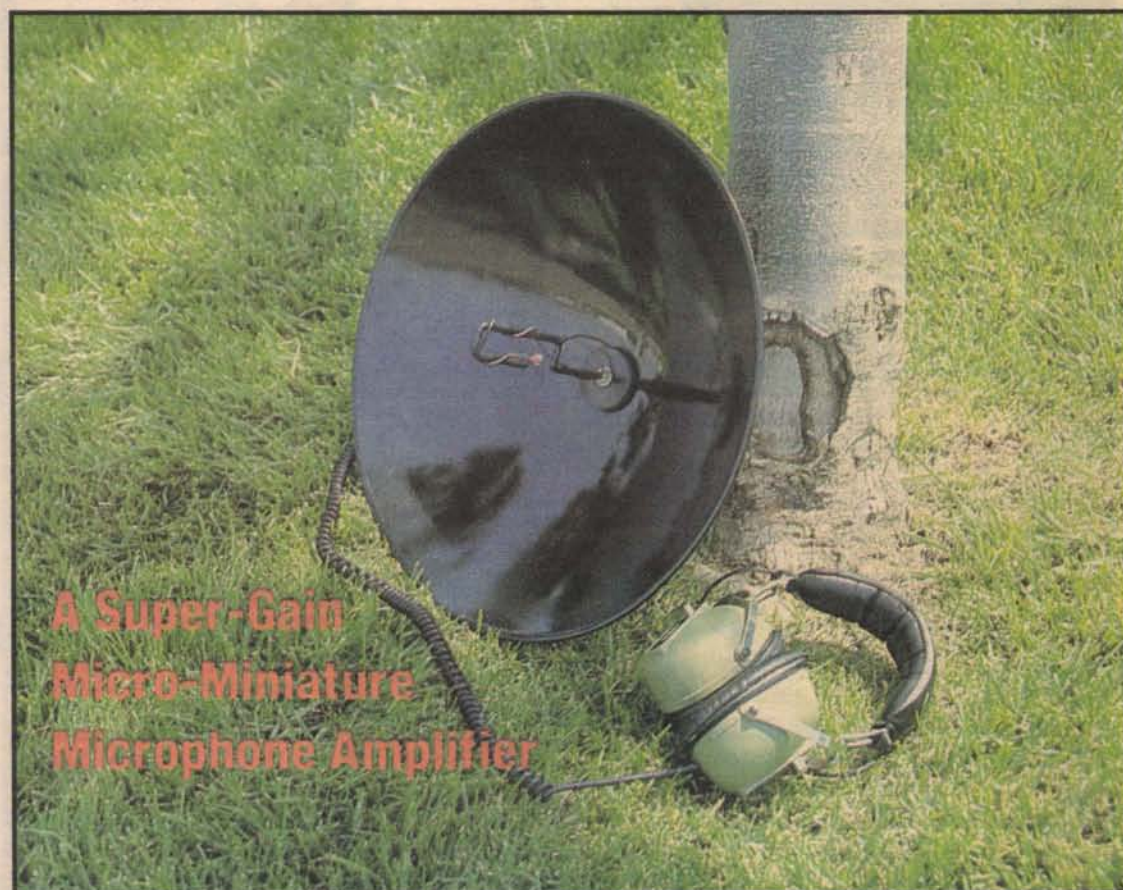
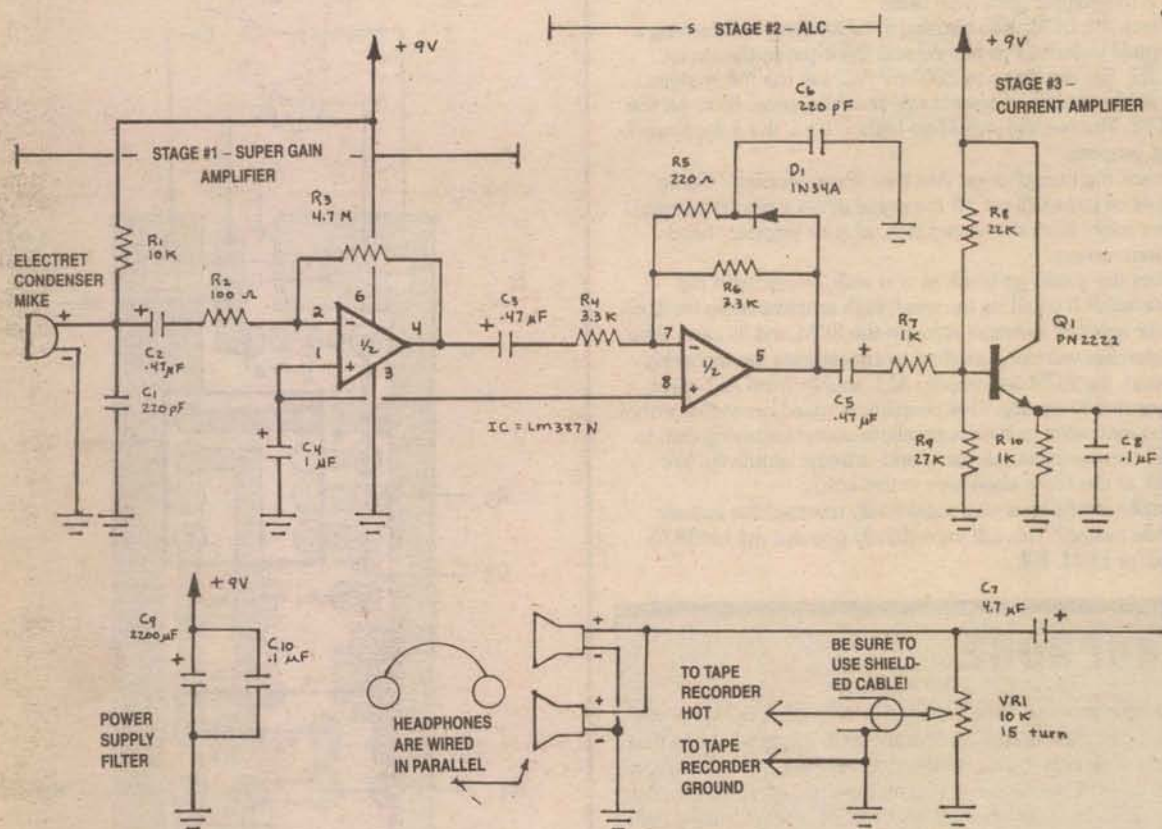


Figure 1 Schematic of Detector '700



shown on the schematic.

- 9) C9 is the largest component on the PC board. Determine whether your enclosure will fit the assembly with C9 standing up, or "hanging" off the back of the PC board. Install C9 accordingly. Note you will have two left-over holes on the board. These are for attaching a tape recorder adapter. Refer to "Improvements" for its implementation.
- 10) Install the LM387N in its socket. Connect up the power switch and battery clip.
- 11) Now to test the circuit! First, carefully check the board for cold solder joints and solder bridges. Connect up a fresh alkaline 9 volt battery to the battery clip. Plug in your headphones. Do not put them on yet. Arrange the ECM so it is away from the headphones, and turn on the power. You should not hear anything yet. Approach the headphones with the ECM. At some point, about 2' away, a feedback whine will be heard which diminishes and changes pitch as you pull away the ECM. Put on the headphones. Now you should hear your surroundings - but greatly amplified. WOW! If you whisper gently towards the mike from two feet away and can hear it, all is well.

Try doing some fun experiments like listening to the bubbler in your fish tank, or the ticking of an old-style clock. My wood

Back View

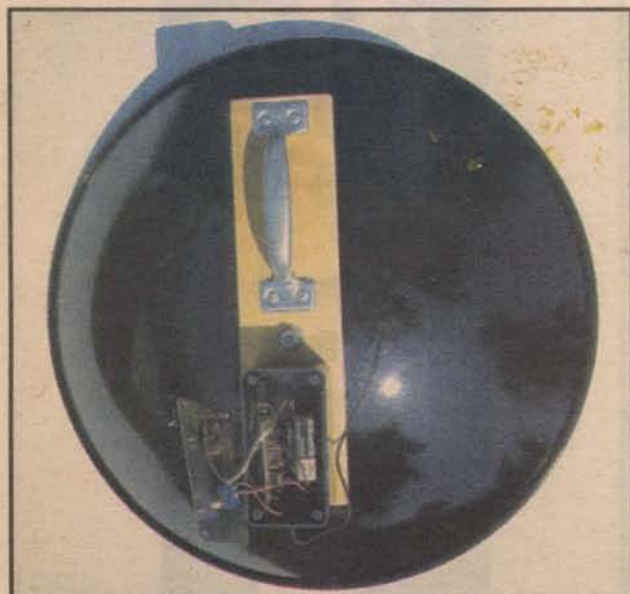


Figure 2

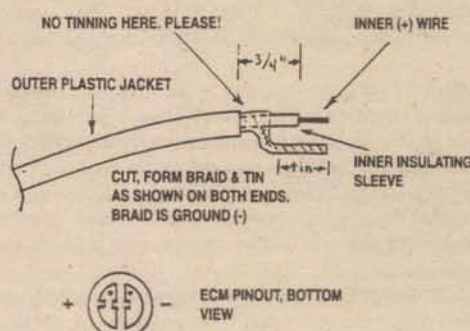
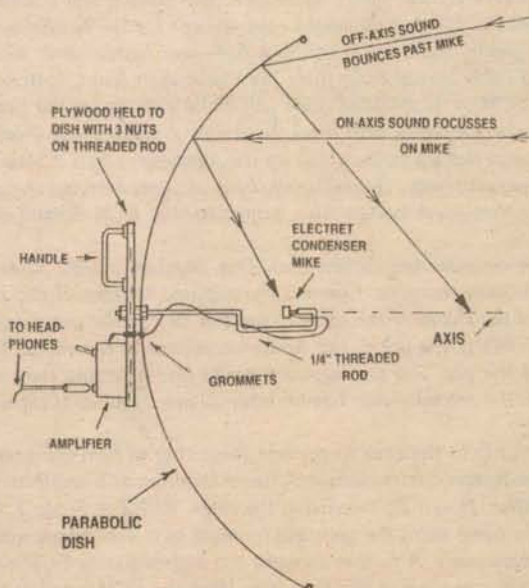


Figure 3



PARTS LIST

All resistors are 1/8 watt, 5% carbon-film unless otherwise indicated.

- R1 10,000-ohm, 1/4 Watt, 1% Metal Film
- R2 100-ohm, 1/4 Watt, 1% Metal Film
- R3 4.7 Meg-ohms
- R4 3,300-ohm
- R5 220-ohm
- R6 3,300-ohm
- R7 1,000-ohm
- R8 22,000-ohm
- R9 27,000-ohm
- R10 1,000-ohm

All electrolytic capacitors are "miniature" type. Voltages other than given may be used, provided they are above 10 WVDC.

- C1 220 pF, ceramic disc
- C2 .47 uF, 50 V electrolytic
- C3 .47 uF, 50 V electrolytic
- C4 1 uF, 50 V electrolytic
- C5 .47 uF, 50 V electrolytic
- C6 220 pF, ceramic disc
- C7 4.7 uF, 16 V electrolytic
- C8 .1 uF, ceramic disc
- C9 2200 uF, 10 V electrolytic
- C10 .1 uF, ceramic disc

Additional Parts:

- D1 1N34, 1N60 or similar germanium diode
- ECM1 electret condenser microphone cartridge, Digi-Key #P9949 or equiv.
- Q1 PN2222, NPN transistor
- IC1 LM387N, dual pre-amp IC in 8-pin case
- 8 pin IC socket
- 1 9-volt battery snap

Miscellaneous Parts:

- 1 9-volt, alkaline battery
- 1 case
- S1 optional push-on/off or snap switch
- 1 8-ohm, full-cover headphones
- J1 headphone jack
- VR1 10,000-ohm, 15-turn potentiometer (optional for Tape Recorder input)

A mini-PC board and kit of all miniature size electronic and "Additional Parts" (minus list of "Miscellaneous Parts") is available from ALLEGRO ELECTRONIC SYSTEMS, Dept. NV-1, 3 Mine Mountain Road, Cornwall Bridge, CT 06754 for \$15 plus \$3 shipping & handling; order #DET-700-PC. Free catalogs w/order. C.O.D. orders: (203) 672-0123.

ECM's, miniature capacitors, resistors and other parts related to this project: DIGI-KEY CORPORATION, 701 Brooks Ave. South, P.O. Box 677, Thief River Falls, MN 56701-0677 (800)-344-4539. Free catalog.

Parabolic dishes: EDMUND SCIENTIFIC COMPANY, 101 East Gloucester Pike Barrington, NJ 08007-1380 (609)-573-6250. A catalog charge may apply.

JUST HOW GOOD IS THE ALC?

To demonstrate the ALC's effectiveness I devised a test. First I used a pair of snug full-cover headphones. Then I loaded up a large blackpowder pistol (these make a terrible KA-BOOM!). Turning on the Detector-700, I first let my ears adapt to the gentle sounds of Nature coming through. Aiming at a tree stump, the pistol was touched off. The ALC worked perfectly, and I was not blasted by the resulting sound but in fact could hear its echo repeatedly bouncing off the hills. (Needless to say, we are located in a remote area, and I recommend less drastic test methods for your Detector 700!)

stove sounds like some sort of haunted inferno when the ECM "looks" at the flames; one hears the whump-whump of the flame and the crackling, sizzling and popping of burning wood sounds very dramatic (do experiments like this from a safe distance, of course). Pour some milk on a bowl of Rice Krispies for real excitement! Bet you never thought walking on a gravel driveway could sound like this ... After you experiment for quite awhile, the battery will run down. Note your battery has to be charged above 8 volts, or the circuit won't work properly. Fortunately, the circuit draws only about 20 mA, so a 9 volt Alkaline battery will last about 12 hours of continuous use before wearing out. An alternative and ultimately much cheaper power source is a true 9 volt Ni-Cad rechargeable battery. Make sure you get a true 9 volt type - most "9 volt" Ni-Cads are actually 7.2 volts, and work poorly with the circuit. Check advertisers in Nuts and Volts for Ni-Cad batteries.

TROUBLESHOOTING

If the circuit fails to work, try these steps to find the problem.

- 1) Did you breadboard the circuit? Remember its gain is too high to function on a breadboard.
- 2) Check battery integrity. Replace with a new 9 volt Alkaline type if needed. Power supplies won't work with this project due to their small amounts of ripple and since they often pick up stray 60 Hz AC from your surroundings.

- 3) Check the orientation of each component. Is their polarity correct?
- 4) Check again for "cold" solder joints and solder bridges. Use of a magnifying glass here helps.
- 5) Check the ECM. You can see if it's working by attaching a Digital Voltmeter at ground and the input to the circuit at R1. Set the range to 200 mV AC. Let the meter settle. A stable reading of several mV should appear. Blow on the ECM. The reading should go higher. If so, the mike is working properly.
- 6) Check the headphones. Are they wired properly? Some types of jacks will cut off the signal when a plug is inserted. You might have the wrong jack, plug or incorrect head phone wiring.
- 7) Does the sound go blank as you walk around with the assembly? It could be the wind, high ambient noise level, or poor acoustic isolation between the ECM and its case. Also, remember without a method to concentrate the incoming sound, the ECM will amplify ALL sounds from ALL directions nearly equally. This property is called *omnidirectional*. You may want to build a parabolic sound-gathering dish to add narrow-angle selectivity and extreme sensitivity. We look at this topic elsewhere in this article.
- 8) Finally, might have you accidentally reversed the battery while testing? This will immediately pop out the LM387N and/or ECM. **NV**

PARABOLIC MICROPHONE

The ultimate in sound-gathering ability can be had with a parabolic dish pick-up. This principle is also used by radio telescopes that listen to weak electromagnetic signals given off by distant celestial objects. A "parabola" is a special shape that concentrates all the sound energy (or more accurately whatever type of energy it was designed to receive) from its narrow geometric axis into a focus point. Off-axis sound simply bounces past the mike. Thus, if a dish had an area of 500 square inches (very roughly a 24" dish) and concentrated all the sound energy onto the .25" diameter opening of the ECM, theoretically a gain of 10,000 could be achieved over the mike by itself. Here, I am not taking into account effects of wave interference, frequency, and a half dozen mitigating factors, but let's just say a dish increases the sound pickup of the Detector '700 by an astounding amount! If you do a good job constructing the dish, expect to be able to hear distant bird chips or perhaps bugs buzzing around a far-away flower.

Figure 3 shows a sketch of a suggested design. You can use an aluminum parabola or perhaps even a Chinese wok which has close to a parabolic shape. Some people have used aluminum or plastic children's "flying saucer" sleds successfully. A 1/4" diameter threaded rod holds the plywood backboard to the dish. It is positioned through a hole drilled in the center of the dish and the plywood backboard. Use nuts and washers as needed to secure the assembly. Threaded rod may be bent quite easily using a large vise and hammer or heating it to red heat with a propane torch and using pliers or a vise to bend it. The electronics package and battery can be mounted in a small non-metallic enclosure attached to the plywood. Grommets are suggested where the shielded mike cable runs through the wood and dish.

Place the ECM as precisely as possible at the focus of the dish, and in-line with the geometric axis - and thus as close to center of what the dish will "hear" as possible. Your care here will determine how much gain the dish will have. Be sure and use ample acoustical insulation between the ECM and the support rod to prevent picking up sounds generated by handling the apparatus. I often use a little silicone RTV mixed with fiberglass insulation as that way you get both support and insulation. Perhaps you can think of a better idea. If unknown, the focal point of the dish may be found by pointing it directly at the sun on a clear day, and using a non-combustible item (say a penny) mounted on the rod. Adjust the rod length until the sun focuses sharpest on the item - that's your focal length. Beware of using anything combustible as a focus indicator as the concentrated infrared energy of the sun will quickly cause it to burst into flames.

Lightweight aluminum parabolas can be bought from Edmund Scientific Company (see Parts List). A suitable mounting can be fabbed from wood to make a tripod. You can also adapt the mount so it mates with a camera tripod. This enables easy continuous pickup of sounds originating from a specific location like, say, animals in their nests. Optionally, an inexpensive rifle scope can be fitted to visually pinpoint the "target" you wish to eavesdrop upon. You could even get real fancy and add laser sighting to it!

IMPROVEMENTS

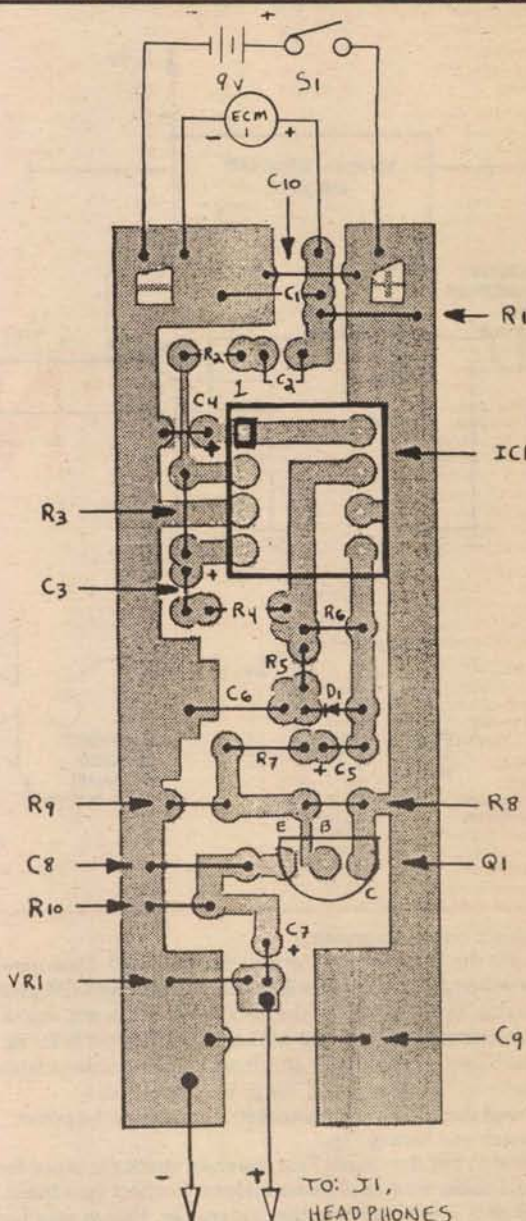
You can use virtually any type of non-metal case. Metal will pick up electrical fields, so avoid it. We made a very compact and unobtrusive prototype unit by putting all the parts in a plastic "C" cell flashlight case, except for the headphones which were full-cover 8 Ohm type. Your hearing power will greatly increase if you have full-cover headphones which block ambient noise. Carefully isolate the ECM, PCB and shielded cable acoustically from their case with foam, cotton or another soft material. Otherwise, every tap and scrape of the case, ECM or its shielded cable will make a thump in the headphones. Remember how high a gain this circuit has! We did have some problems with wind, however. A cover made from a few criss-crossed layers of plastic flyscreen cemented where the lens was helped by breaking up the airstream when it blew at the ECM. Similar to the screen used on regular microphones. Use ingenuity here. If your application requires carrying the circuit around and/or exposure to wind, your mike cover will have to be that much better. Also, remember the ECM doesn't like water.

An option is provided for attaching the Detector '700 to a tape recorder (see Schematic). This requires a 10K, 15-turn potentiometer, a length of shielded cable, and the proper jack to fit your recorder. Connect the top and bottom of the pot (Pins #1 and #3) to ground and the output pad respectively. Connect the shield of the cable to ground, and to the ground terminal of the recorder's jack. Next, connect the wiper (middle pin or #2) of the pot to the center conductor of the cable. The jack's hot terminal is connected to this also. By varying the level of the pot, you can experimentally find a setting that will enable recording the Detector '700's output. A word of caution here: the recorder also has an internal amplifier, so if the setting of the pot is too high, all you'll get is feedback whine.



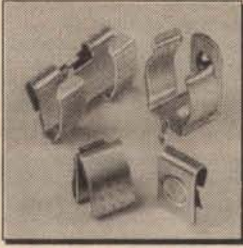
To help conserve batteries, you might add a low-current flashing LED to the case to prevent forgetting to turn the power switch off. Check the data sheet for the LM3909N LED Flasher IC for typical circuits (available from Digi-Key at a small cost).

You can improve this circuit by stepping up the gain of the amplifier. How? By increasing the ratio $R3/R2$ in Stage 1. Or add some gain to Stage 2 by tinkering with the $R6/R4$ ratio. Expect at some point the gain will increase to a level where internally generated noise is substantial - or the circuit will oscillate spontaneously. A further thought is a higher-quality ECM that has less internal noise. This is specified by "Signal-to-Noise Ratio," and expressed in decibels (dB). With the ECM listed in the Parts List it is greater than 40 dB. The more sensitive the ECM is the better, too. Again, this is expressed in dB, and for instance a -70 dB sensitivity is better than -64 dB.

Component Placement Diagram - Component Side



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WESTERN REGION

JULY 3

CA - GLENDALE — California Computer Show & Sale. **LOCATION:** Glendale Civic Auditorium, 1401 N. Verdugo Rd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - R - H. **DEALER INFO:** \$6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

CA - VENTURA — MarketPro Computer Show & Sale. **LOCATION:** Ventura County Fairgrounds Commercial Bldg., Ventura Ave. **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

JULY 4

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Los Positas College, N of I-580 at Airway Blvd. exit. **HOURS:** 7am-12noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045 + fr west, 145.350- (100Hz) fr east. **FEATURES:** H - E - FP - F/R. **DEALER INFO:** \$10 space fee. Covered spaces avail. If rain. **CONTACT:** Noel Ankiam KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

JULY 10

CA - LOS ALTOS HILLS — Foothill College Amateur Radio Flea Market. **LOCATION:** Foothill College, Hwy 280, exit El Monte Rd West. **HOURS:** 7am-11am. **ADMISSION:** Free. **TALK-IN:** 145.270(-). **FEATURES:** H - E - EX - F/R. **DEALER INFO:** \$10 (two spaces). **CONTACT:** 408-734-4453, Sunnyvale VEC, P.O. Box 60307, Sunnyvale, CA 94088-0307. Exam info: 408-255-9000.

CA - OCEANSIDE — Swap Meet - Special Section for Ham Radio, Electronics & Computers. **SPONSOR:** Palomar Ham Radio Club. **LOCATION:** Oceanside Drive-In, 3480 Mission Ave. **HOURS:** 6:30am-3:30pm. **ADMISSION:** 50¢. **FEATURES:** C - E - H. **DEALER INFO:** \$13 per space. 6am setup. **CONTACT:** 619-757-5286 vendors.

CA - RIVERSIDE — MarketPro Computer Show & Sale. **LOCATION:** Riverside Convention Center. **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - SAN FRANCISCO — California Historical Radio Society Swapmeet. **LOCATION:** St. Anne of the Sunset Church, Funston at Irving St. **DEALER INFO:** 8am setup. **CONTACT:** John Wentzel, 415-731-1920 or CHR, 415-978-9100, 24 hr. info.

CA - SAN JOSE — California Computer Show & Sale. **LOCATION:** Santa Clara County Fairgrounds, 344 Tully Rd. **HOURS:** 10am-4pm. **ADMISSION:** \$6; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

OR - SALEM — Northwest Vintage Radio Society Swap Meet. **LOCATION:** 7455 O'Neil Rd. **HOURS:** 8am-2pm. **CONTACT:** Speed Feldschau, 503-390-3928.

JULY 10-11

CA - NORTHRIDGE — California Computer Show & Sale. **LOCATION:** California State University, North Campus, 18000 Devonshire Blvd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

JULY 11

CA - CONCORD — MarketPro Computer Show & Sale. **LOCATION:** Centre Concord. **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - SACRAMENTO — California Computer Show & Sale. **LOCATION:** Rancho Arroyo Sports Complex, 9880 Jackson Rd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

CA - SAN DIEGO — MarketPro Computer Show & Sale. **LOCATION:** Scottish Rite Center, 1895 Camino Del Rio So. (Exit Mission Center off I-8). **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

Events CALENDAR

The Events Calendar is a free service limited to electronic events such as computer shows, hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days prior to the event. Include your flyer, estimated attendance, name of person to contact and phone number. Complimentary issues are available upon request for distribution to your attendees. A street address for UPS shipment is required.

While we strive for accuracy in our calendar, we cannot be responsible for errors or cancellations. The information contained in this column is for the use of the readers of Nuts & Volts and may not be republished in any form without the written permission of T & L Publications, Inc.

JULY 11-12-13-14

NV - LAS VEGAS — 12th Annual Convention. **SPONSOR:** Video Software Dealers Assoc. **CONTACT:** VSDA, 609-231-7800.

JULY 17

CA - OAKLAND — California Computer Show & Sale. **LOCATION:** Oakland Coliseum, I-880 and Hegenberger Rd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

CA - POMONA — Computer Trade Show. **SPONSOR:** Computer Marketplace. **LOCATION:** LA County Fairgrounds (Fairplex). Exit Hwy 10 at Fairplex Dr. N to McKinley, turn rt. Lft on White Ave. to Gate 14. **HOURS:** 10am-5pm. **ADMISSION:** \$7. **FEATURES:** C - CB - S. **CONTACT:** Computer Marketplace, 408-778-5200 or 800-800-5600.

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - R - H. **DEALER INFO:** \$6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

WA - VANCOUVER — Amateur Radio Electronics & Computer Flea Mart. **SPONSOR:** Portland Amateur Radio Club. **LOCATION:** Clark Utilities Service Electric Bldg., 1200 Fort Vancouver Way. **HOURS:** 8am-2:30pm. **TALK-IN:** 146.84. **FEATURES:** F/R - T. **DEALER INFO:** Setup 7am. Large tables \$7, small tables & tailgaters \$5. Bring your own table & save \$1. **CONTACT:** KA7ICV, John 503-281-0798.

JULY 18

AZ - PHOENIX — Computer & Electronic Swap Meet. **SPONSOR:** Electronic Materials & Computers. **HOURS:** 8am-3pm. **ADMISSION:** Free. **FEATURES:** FP. **DEALER INFO:** Vendor spaces \$10. **CONTACT:** 3102 W Thomas Rd. #902, Phoenix AZ 85017. 602-272-3200.

CA - RESEDA — Computer Trade Show. **SPONSOR:** Computer Marketplace. **LOCATION:** Sherman Entertainment Center, 18430 Sherman Way. **HOURS:** 10am-5pm. **ADMISSION:** \$7. **FEATURES:** C - CB. **CONTACT:** Computer Marketplace, 408-778-5200 or 800-800-5600.

CA - SACRAMENTO — MarketPro Computer Show & Sale. **LOCATION:** Scottish Rite Center. **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

JULY 24

CA - ANAHEIM — California Computer Show & Sale. **LOCATION:** Anaheim Stadium - Indoors, 2000 State College Blvd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

CA - OXNARD — MarketPro Computer Show & Sale. **LOCATION:** Civic Auditorium, 800 Hobson Way (Exit Vineyard Ave So. off Hwy 101). **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - SAN MATEO — California Computer Show & Sale. **LOCATION:** San Mateo County Expo Center, 2495 S. Delaware. **HOURS:** 10am-4pm. **ADMISSION:** \$6; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

CA - SANTA BARBARA — Computer Trade Show. **SPONSOR:** Computer Marketplace. **LOCATION:** Earl Warren Showgrounds, Hwy 101 to Las Positas. **HOURS:** 10am-5pm. **ADMISSION:** \$7. **FEATURES:** C - CB. **CONTACT:** Computer Marketplace, 408-778-5200 or 800-800-5600.

OR - NORTH BEND — Southern Oregon Coast

Hamfest. SPONSOR: Coos County Radio Club. **LOCATION:** Junior High School. **HOURS:** 9am-5pm. **ADMISSION:** \$4 adv., \$5 door. Free RV parking all weekend. **TALK-IN:** 146.01/.61. **FEATURES:** DP - EX - FP - F/R - S. **DEALER INFO:** Tables \$10. **CONTACT:** Coos County Radio Club, POB 3494, Coos Bay OR 97420. 503-396-4479.

JULY 25

CA - HAYWARD — MarketPro Computer Show & Sale. **LOCATION:** Centennial Hall, 22292 Foothill Blvd. (I-580 to Hwy 238. **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - LANCASTER — MarketPro Computer Show & Sale. **LOCATION:** Antelope Valley Fairgrounds, 155 E. Avenue 1 (I-5 No. to Hwy 14). **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - SANTA ANA — ACP Computer Swap Meet. **SPONSOR:** Advanced Computer Products. **LOCATION:** 1310 E. Edinger. **HOURS:** 8am-2pm, rain or shine. **ADMISSION:** Free. **FEATURES:** C - E - FP. **DEALER INFO:** All spaces \$75 in advance. Call for multiple pricing. **CONTACT:** Mary Russo - 714-558-8813.

JULY 31

CA - NORTHRIDGE — California Computer Show & Sale. **LOCATION:** California State University, North Campus, 18000 Devonshire Blvd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad;

All listing information should be sent to:

**Nuts & Volts Magazine
EVENTS CALENDAR
430 Princeland Court
Corona, CA 91719
Phone 909-371-8497
FAX 909-371-3052**

JULY 31-AUGUST 1

CA - SAN FRANCISCO — California Computer Show & Sale. **LOCATION:** Cow Palace, corner of Geneva and Santos. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

AUGUST 1

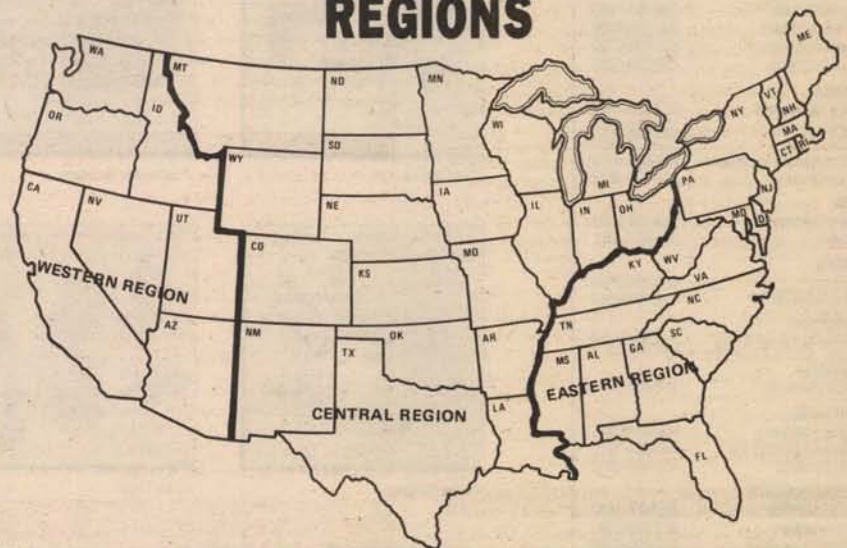
CA - GLENDALE — California Computer Show & Sale. **LOCATION:** Glendale Civic Auditorium, 1401 N. Verdugo Rd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Los Positas College, N of I-580 at Airway Blvd. exit. **HOURS:** 7am-12noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045 + fr west, 145.350- (100Hz) fr east. **FEATURES:** H - E - FP - F/R. **DEALER INFO:** \$10 space fee. Covered spaces avail. If rain. **CONTACT:** Noel Ankiam KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

AUGUST 7

CA - OAKLAND — California Computer Show & Sale. **LOCATION:** Oakland Coliseum, I-880 &

REGIONS



FEATURES KEY

AC	— Air-conditioned
B	— Banquet
C	— Computers
CB	— Commercial Booths
DP	— Door Prizes
E	— Electronics
EX	— FCC exams
F	— Forums
FM	— Flea Market
FP	— Free Parking
F/R	— Food & Refreshments
H	— Amateur Radio
RV-H	— RV Parking w/hookups
RV-S	— RV Parking Self-contained
S	— Seminars
T	— Tailgating

COMPUTER SHOW PROMOTER INFO

AGI Computer Fair - 317-293-9665
California Computer S & S, Richard James
800-685-1400 - BBS 800-340-9370
Computer Central - 708-940-7547
Computers & You, R. Nagy - 313-283-1754
KGP Computer Shows - 800-631-0062
MarketPro Computer Shows - 415-388-8893
NARISAAM Computer Shows - 407-393-1794
PC Fest Computer Shows - 407-746-4414
R&L Computer Fairs & FM - 303-666-0878
Tri-State Computer Fairs - 201-533-1991
Tri-State NE - 203-233-9922

Events CALENDAR

Hegenberger Rd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - R - H. **DEALER INFO:** \$6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

AUGUST 7-8

CA - POMONA — Computer Trade Show. **SPONSOR:** Computer Marketplace. **LOCATION:** LA County Fairgrounds (Fairplex). Exit Hwy 10 at Fairplex Dr. N to McKinley, turn rt. Lft on White Ave. to Gate 14. **HOURS:** 10am-5pm. **ADMISSION:** \$7. **FEATURES:** C - CB - S. **CONTACT:** Computer Marketplace, 408-778-5200 or 800-800-5600.

AUGUST 8

CA - SACRAMENTO — California Computer Show & Sale. **LOCATION:** Rancho Arroyo Sports Complex, 9880 Jackson Rd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

CA - SAN DIEGO — MarketPro Computer Show & Sale. **LOCATION:** Scottish Rite Center, 1895 Camino Del Rio So. (Exit Mission Center off I-8). **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - SAN RAFAEL — MarketPro Computer Show & Sale. **LOCATION:** Marin Civic Center Exhibit Hall, Civic Center Dr. (Exit San Pedro East off Hwy 101). **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

AUGUST 14

CA - LOS ALTOS HILLS — Foothill College Amateur Radio Flea Market. **LOCATION:** Foothill College, Hwy 280, exit El Monte Rd West. **HOURS:** 7am-11am. **ADMISSION:** Free. **TALK-IN:** 145.270(-). **FEATURES:** H - E - EX - F/R. **DEALER INFO:** \$10 (two spaces). **CONTACT:** 408-734-4453, Sunnyvale VEC, P.O. Box 60307, Sunnyvale, CA 94088-0307. Exam info: 408-255-9000.

CA - NORTHIDGE — California Computer Show & Sale. **LOCATION:** CSUN, North Campus, 18000 Devonshire Blvd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

CA - OCEANSIDE — Swap Meet - Special Section for Ham Radio, Electronics & Computers. **SPONSOR:** Palomar Ham Radio Club. **LOCATION:** Ocean-side Drive-In, 3480 Mission Ave. **HOURS:** 6:30am-3:30pm. **ADMISSION:** 50¢. **FEATURES:** C - E - H. **DEALER INFO:** \$13 per space. 6am setup. **CONTACT:** 619-757-5286 vendors.

CA - SANTA ROSA — MarketPro Computer Show & Sale. **LOCATION:** Sonoma County Fairgrounds, 1350 Bennet Valley Rd (exit Hwy 12 E off Hwy 101). **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

WA - TACOMA — Tacoma Electronics Fleamarket. **SPONSOR:** Radio Club of Tacoma. **LOCATION:** Camp Murray Armory. **HOURS:** 9am-3pm. **ADMISSION:** \$4, under 12 free. **TALK-IN:** 147.28. **FEATURES:** C - CB - EX - FP - H - RV-S. **DEALER INFO:** Tables: 6' non-commercial \$15 ea., 8' commercial \$40 ea. Setup Fri. 5-9pm & Sat. 5-9am. Overnight RVs \$2, self contained Fri. only. **CONTACT:** 206-845-8346 or 206-475-7413 evenings.

AUGUST 15

CA - CONCORD — MarketPro Computer Show & Sale. **LOCATION:** Centre Concord. **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - OXNARD — MarketPro Computer Show & Sale. **LOCATION:** Civic Auditorium, 800 Hobson Way (Exit Vineyard Ave So. off Hwy 101). **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - PLEASANTON — California Computer Show & Sale. **LOCATION:** Alameda County Fairgrounds, 4501 Pleasanton Ave. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

AUGUST 21

CA - ANAHEIM — California Computer Show & Sale. **LOCATION:** Anaheim Stadium - Indoors, 2000 State College Blvd. **HOURS:** 10am-4pm. **ADMISSION:** \$6 - \$1 off with copy of this ad; under 12 free. **FEATURES:** C - DP. **CONTACT:** California Computer Show/RJI.*

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - R - H. **DEALER INFO:** \$6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

WA - LONGVIEW — Ham Radio, Computer & Electronic Equipment Swap Meet. **SPONSOR:** Lower Columbia Amateur Radio Assn. **LOCATION:** Cowlitz County Fairgrounds. **HOURS:** 9am-3pm. **ADMISSION:** \$2. **TALK-IN:** 147.26+. **FEATURES:** CB - RV-H - T. **DEALER INFO:** Tables \$10, tailgate space \$5, commercial space \$40, RV overnight \$10 w/electrical hookup. **CONTACT:** 206-425-6076, 206-425-9184, 206-425-1866.

AUGUST 22

CA - SACRAMENTO — MarketPro Computer Show & Sale. **LOCATION:** Scottish Rite Center, 6151 H St. **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

AUGUST 28

CA - POMONA — Computer Trade Show. **SPONSOR:** Computer Marketplace. **LOCATION:** LA County Fairgrounds (Fairplex). Exit Hwy 10 at Fairplex Dr. N to McKinley, turn rt. Lft on White Ave. to Gate 14. **HOURS:** 10am-5pm. **ADMISSION:** \$7. **FEATURES:** C - CB - S. **CONTACT:** Computer Marketplace, 408-778-5200 or 800-800-5600.

CA - VALLEJO — MarketPro Computer Show & Sale. **LOCATION:** Solano County Fairgrounds, 900 Fairgrounds Dr. (Exit Hwy 37 off I-80). **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

AUGUST 29

CA - SAN RAFAEL — MarketPro Computer Show & Sale. **LOCATION:** Marin Civic Center Exhibit Hall, Civic Center Dr. (Exit San Pedro East off Hwy 101). **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 4

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** Amateur Radio Club of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **OPENS:** Appx. 6:30am, rain or shine. **ADMISSION:** 50 cents. **TALK-IN:** 146.520. **FEATURES:** C - E - F - R - H. **DEALER INFO:** \$6/vehicle. **CONTACT:** N6RGM Sonny 619-444-6532; WA6MHZ Pat 619-561-0052; ARCEC, Box 50, El Cajon CA 92020.

CA - VENTURA — MarketPro Computer Show & Sale. **LOCATION:** Ventura County Fairgrounds Commercial Bldg., Ventura Ave. **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

SEPTEMBER 5

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet. **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Los Positas College, N of I-580 at Airway Blvd. exit. **HOURS:** 7am-12noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045+ fr west, 145.350- (100Hz) fr east. **FEATURES:** H - E - FP - F/R. **DEALER INFO:** \$10 space fee. Covered spaces avail. If rain. **CONTACT:** Noel Anklam KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

CA - SAN DIEGO — MarketPro Computer Show & Sale. **LOCATION:** Scottish Rite Center, 1895 Camino Del Rio So. (Exit Mission Center off I-8). **HOURS:** 10am-5pm. **ADMISSION:** \$6. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CENTRAL REGION

JULY 9-10-11

ND - DUNSEITH — VE4 International Hamfest. **SPONSOR:** North Dakota & Manitoba Clubs. **LOCATION:** US Lodge Int'l Peace Garden, US & Canadian border. **TALK-IN:** 146.52/52. **FEATURES:** DP - EX - FM. **CONTACT:** Dave Nydal, 25 Queens Crescent, Brandon, Manitoba, Canada R7B 1G1, 204-728-2463.

JULY 10

CO - DENVER — Computer Fair & Flea Market. **SPONSOR:** R & L Computer. **LOCATION:** Holiday Inn, 4849 Bannock. **HOURS:** 9:30am-2:30pm. **ADMISSION:** Free. **FEATURES:** C. **DEALER INFO:** Tables \$15 ea, 8:30am setup. **CONTACT:** R&L Computer Shows.*

MI - LIVONIA — Computer Trade Show. **LOCATION:** Livonia Elks Hall, 31117 Plymouth Rd, 1 Bldk

E of Merriman. **HOURS:** 10am-3pm. **ADMISSION:** Adults \$4; Seniors \$3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You*

MI - PETOSKEY — SAARC Swap & Shop. **SPONSOR:** Straits Area Amateur Radio Club. **LOCATION:** Emmet County Fairgrounds, US 31, 2 blocks W of US 131. **HOURS:** 8am-1pm. **ADMISSION:** \$3. **TALK-IN:** 148.68. **FEATURES:** CB - DP - EX. **DEALER INFO:** Tables \$5 splits allowed. **CONTACT:** Harry Leiber N8OIV, 616-347-6610.

MI - WESTLAND — Great Lakes Computer Expo. **SPONSOR:** Progressive Computer Productions. **LOCATION:** Wayne-Ford Civic League, 1645 Wayne Rd, 1 blk S of Ford Rd next to Paddy's Pub. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4, Seniors/Students \$3, under 12 free w/adult. **FEATURES:** C - DP - FP - F/R. **DEALER INFO:** 8' \$25 ea, 12' \$35 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave., Ste 237, Dearborn MI 48124, 313-425-9276.

WI - OAK CREEK — Swapfest. **SPONSOR:** South Milwaukee Amateur Radio Club. **LOCATION:** American Legion Post #434, 9327 S Shepard Ave. **HOURS:** 7am-2pm. **ADMISSION:** \$4. **TALK-IN:** 146.580. **FEATURES:** DP - EX - F/R. **CONTACT:** The South Milwaukee Amateur Radio Club, POB 102, South Milwaukee WI 53172-0102, 414-762-3235 ext. 58.

JULY 10-11

IN - INDIANAPOLIS — 23rd Annual Indianapolis Hamfest & ARRL Central Division Convention. **LOCATION:** Marion County Fairgrounds. **CONTACT:** Indianapolis Hamfest Assn., POB 11776, Indianapolis IN 46201, 317-251-4407.

JULY 11

IL - DOWNERS GROVE — 11th Annual Hamfest. **SPONSOR:** Du Page Amateur Radio Club. **LOCATION:** American Legion Post 80, 4000 Saratoga Ave. **HOURS:** 8am-7. **ADMISSION:** \$3 adv, \$4 door. **TALK-IN:** 145.250-600, 146.52. **FEATURES:** DP - EX - FM - FP - F/R - T. **DEALER INFO:** Setup 6 am. **CONTACT:** Ed Weinstein, 708-985-9256.

MI - MADISON HEIGHTS — Computer Trade Show. **LOCATION:** UF & CW Hall, 876 Horace Brown Dr., 1 blk E of I-75, on 13 Mile Rd. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4; Seniors & Students \$3; under 12 free w/adult. **FEATURES:** C - DP - FP. **CONTACT:** Computers & You.*

OH - BOWLING GREEN — Ham-A-Rama 1993. **SPONSOR:** Wood County Amateur Radio Club. **LOCATION:** Wood County Fairground. **HOURS:** 8am-1pm. **ADMISSION:** Free. **TALK-IN:** 147.78/.18. **FEATURES:** DP - FP - T. **DEALER INFO:** Trunk sales \$5 per space, inside sales \$10 per table. **CONTACT:** Wood County Amateur Radio Club, POB 534, Bowling Green OH 43402, 419-352-0856.

JULY 16-17

MN - MAPLEWOOD — Electronics Fair. **SPONSOR:** North Area Repeater Assn. **LOCATION:** Aldrich Arena, 1850 White Bear Ave. **ADMISSION:** \$6 for both days, under 6 free. **FEATURES:** CB - DP - FM - FP. **DEALER INFO:** Outdoor flea market \$4 per vehicle. **CONTACT:** Electronics Fair, POB 26331, St. Paul MN 55126, 612-653-9999.

JULY 16-17-18

MI - LANSING — Extravaganza '93. **SPONSOR:** Michigan Antique Radio Club. **LOCATION:** Holiday Inn South Convention Center, 517-694-8123. **FEATURES:** DP - FM. **CONTACT:** Extravaganza '93, POB 585, Okemos MI 48864.

JULY 17

IL - ROLLING MEADOWS — Midwest Computer Flea Market. **SPONSOR:** Midwest Shows. **LOCATION:** Rolling Meadows Holiday Inn, 3405 Algonquin Rd. **HOURS:** 9:30am-3pm. **ADMISSION:** \$3. **DEALER INFO:** 45 tables. 6' \$40. **CONTACT:** Midwest Shows, 8749 S. Harlem #197, Bridgeview IL 60455, 312-666-9500.

IN - HIGHLAND — Computer Possibilities Unlimited. **SPONSOR:** Bee Software. **LOCATION:** Lincoln Center, 2450 Lincoln. **HOURS:** 10am-3pm. **ADMISSION:** \$5, under 12 free. **FEATURES:** AC - C - DP - FP - F/R - S. **CONTACT:** info/Discount tickets: 219-931-3761.

OH - WELLINGTON — NOARSFEST. **SPONSOR:** Northern Ohio Amateur Radio Society. **LOCATION:** Lorain County Fairgrounds on Rt 18. **HOURS:** 8am-7. **ADMISSION:** \$4 adv, \$5 door. **DEALER INFO:** Setup 6am. Tables \$10 ea. **CONTACT:** Dee Dee Ohman, KABVTS, 4122 Bush Ave, Cleveland OH 44109, 216-398-8858 6pm-11pm EST.

JULY 18

IL - ORLAND PARK — Chicagoland Computer Fair & Flea Market. **LOCATION:** Orland Park Civic Center, 147th St & LaGrange Rd (Rt. 45). **HOURS:** 9:30am - 2:30pm. **ADMISSION:** Adults \$5 - \$1 off with copy of this ad, 8-12 yrs \$2, under 8 free.

FEATURES: AC - C - CB - DP - FM - FP - F/R. **CONTACT:** 24-hour Hotline 708-974-3123.

MO - WASHINGTON — 31st Annual Hamfest. **SPONSOR:** Zero Beaters Amateur Radio Club. **LOCATION:** Bernie H. Hillerman Park, Washington Fairgrounds. **HOURS:** 6am-3pm. **ADMISSION:** Free. **TALK-IN:** 147.240+. **FEATURES:** CB - EX - FM - FP - F/R - S. **DEALER INFO:** Flea market parking \$4 per space. **CONTACT:** Ed Southall WDOELL, POB 24 Dutzow MO 63342, 314-459-6581 or 314-239-0060.

OH - VAN WERT — 6th Annual Van Wert Hamfest. **SPONSOR:** Van Wert Amateur Radio Club. **LOCATION:** Van Wert County Fairgrounds, US Rt. 127. **HOURS:** 8am-4pm. **ADMISSION:** \$4. **TALK-IN:** 146.850. **FEATURES:** DP - EX - FM - FP - F/R. **DEALER INFO:** Setup 6am. Tables \$8 each, space w/o table \$6, outside space \$4. **CONTACT:** Van Wert ARC, Box 602, Van Wert OH 45891, or call Bob Barnes 419-238-1877 eves or Jack Snyder 419-495-2209 days.

JULY 24

WI - CHIPPEWA FALLS — Eau Claire Hamfest '93. **SPONSOR:** Eau Claire Amateur Radio Club & PC User Group. **LOCATION:** Chippewa County Fairgrounds. **HOURS:** 7:30am-2pm. **ADMISSION:** \$3. **TALK-IN:** 146.91/31. **FEATURES:** CB - DP - EX - FP - F/R. **DEALER INFO:** 8' tables \$3, commercial tables \$5. **CONTACT:** Liz Searing N9EQR, 715-834-1303.

JULY 24-25

CO - WOODLAND PARK — 12th Annual MARC Swapfest Campout. **SPONSOR:** Mountain Amateur Radio Club. **LOCATION:** Red Rocks Campground in the Pikes National Forest on Hwy. 67. **TALK-IN:** 146.82. **FEATURES:** DP - F/R. **DEALER INFO:** Gates open for overnight campers Fri. eve. Camping and/or selling \$7.50 per day. Bring own tables or tailgate. **CONTACT:** MARC, Box 1012, Woodland Park CO 80866-1012. Bob 719-687-9025 or Fred/Patty 719-687-9727.

OK - OKLAHOMA CITY — Ham Holidays '93. **SPONSOR:** Central Oklahoma Radio Amateurs. **LOCATION:** Oklahoma State Fair Park, NE of I-40 & I-44. **HOURS:** Sat. 8am-5pm, Sun. 8am-2pm. **ADMISSION:** \$6 adv., \$8 door. **TALK-IN:** 147.03/63. **FEATURES:** B - CB - DP - EX - F - FM - FP - S. **CONTACT:** CORA - Ham Holidays, POB 95942, Oklahoma City OK 73143-5942, 405-677-5291.

JULY 25

IL - GLEN ELLYN — Computer Central. **LOCATION:** College of DuPage, Physical Education Bldg, Main Arena, Park Blvd. & College Rd. **HOURS:** 9:30am-3pm. **ADMISSION:** Adults \$6, 8-12 \$2, under 8 free. **FEATURES:** C - FP - AC. **CONTACT:** Computer Central.*

OH - ASHTABULA — Ashtabula County Hamfest & Computer Show. **SPONSOR:** Ashtabula County ARC. **HOURS:** 8am-2pm. **CONTACT:** Ken Stenback, 722 Lyndon Ave, Ashtabula OH 44004, 216-964-7316.

JULY 30-31

MI - MANISTIQUE — '93 U.P. Hamfest. **SPONSOR:** Manistique Amateur Radio Assoc. **LOCATION:** Schoolcraft County Fair Bldg. **HOURS:** 6am-5pm. **DEALER INFO:** Setup Fri. afternoon, Fri. night fish fry. Registration \$5, table space \$5 per 4 ft. **CONTACT:** Debra K. Barton, 906-341-5694 eves, or MARA, POB 144, Manistique MI 49854.

JULY 30-31-AUGUST 1

CANADA - REGINA, SASKATCHEWAN — Regina Hamfest '93. **SPONSOR:** Regina ARA. **LOCATION:** Luther College, University of Regina campus. **CONTACT:** Lyle Hopwood VE5HL, 4530 3rd Ave., Regina, Saskatchewan S4S 0E8, Canada.

AUGUST 1

CO - COLORADO SPRINGS — Computer Fair & Flea Market. **SPONSOR:** R&L Computer. **LOCATION:** Holiday Inn, 3125 Sinton Rd. **HOURS:** 9:30am-2:30pm. **ADMISSION:** Free. **FEATURES:** C. **DEALER INFO:** 8:30am setup. **CONTACT:** R&L Computer Shows.*

IL - SUGAR GROVE — Fox River Radio League Hamfest. **LOCATION:** Waubesa Community College, Rte 47 at Harter Rd. **HOURS:** 8am-7. **ADMISSION:** \$4 adv., \$5 gate. **TALK-IN:** 144.87/145.47. **FEATURES:** C - CB - EX - FM - FP - F/R. **DEALER INFO:** Setup Sat. 7pm, Sun. 6-8am. Tables \$10 8'. **CONTACT:** Bill Schaben WA9AUW, 708-208-4870 or Don Rasmussen N9III, 800-472-7826.

IN - CROOKED LAKE — Land of Lakes Angola Hamfest. **LOCATION:** Steuben County 4-H Park. **ADMISSION:** \$3 adv, \$4 gate. **TALK-IN:** 147.180. **FEATURES:** DP - FP - F/R - T. **DEALER INFO:** Tables \$6, trunk sales \$2. **CONTACT:** Land of Lakes Angola Hamfest, Sharon Brown WD9DSP, 905 W. Parkway Dr., Pleasant Lake IN 46779, 219-475-5897.

Continued on page 42

Dear Nuts & Volts:

Judging from his column in your June issue, Don Lancaster hasn't kept up with recent developments in ham radio.

Don asserts "the number of radio hams is down..." The number of hams in the United States in February, 1990 was 463,127. In February, 1993, there were 596,225 hams in the United States.

Better check your facts before you write, Don!

The reason for this growth is the 1990 FCC decision to eliminate the Morse code test requirement from the Technician class license exam. Passing a 55 question multiple-choice exam now gives you complete access to all ham frequencies above 30MHz and all operating privileges, including voice, televi-

sion, satellite, and digital modes. The Technician test is regularly administered by already-licensed hams at hundreds of locations around the country.

I was really surprised at the short mention Don gave to packet radio. This is an on-the-air version of Internet complete with orbiting ham radio satellites (called "pacsats") that upload and download

messages from terrestrial stations. Also, packet radio doesn't use repeaters; it uses something called a "digipeater" to link stations together. Repeater and digipeaters are two very different animals. And the six meter band is used for a lot more than just "local handheld" communications as stated by Don. Some people have conducted voice communications with other 100 countries on that band, and it's also popular for radio control applications.

If you'd like more information on ham radio and exam schedules, contact either the American Radio Relay League (225 Main St., Newington, CT, 06111) or W5YI VEC (P.O. Box 565101, Dallas, TX, 75356-5101). And when you get your license, look for a station indentifying itself as AA6FW on the air — that's me, and I'd like to say hello to you!

Harry L. Helms
Solana Beach, CA



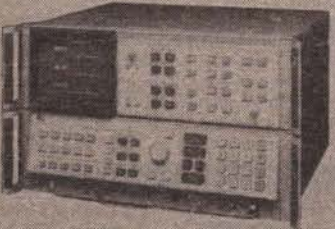
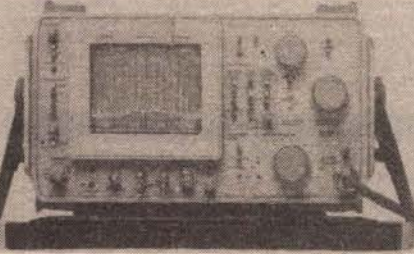
Dear Nuts & Volts:

After thoroughly reading the March 1993 issue, I noticed an error in Mr. Blechman's article on page 18, "Build an LED Metro-nome." Although the theory of operation is basically correct, the author repeatedly refers to the count sequence of IC4 as being binary coded decimal. IC4, a 4029 counter, follows the standard binary count sequence — using four data bits to represent the sixteen possible states. BCD requires five bits to achieve the same result.

I raise the issue solely to circumvent confusion among the novice "tinker" ranks, with no intention of discrediting the author. I hope you will agree that the difference between binary and BCD is significant enough to warrant the clarification.

I thoroughly enjoy Nuts & Volts, especially the articles and projects. For what it's worth, as a former subscriber to Elektor Electronics USA, I, like Mr. Lancaster, was also dismayed to see EEUSA close their doors. Thank you for providing a fine periodical and the opportunity to express an opinion.

David Daffron
Fort Leavenworth, KS

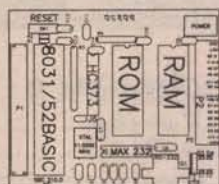
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TEKTRONIX PG 506, TG 501, SG 503, & SG 504 IN A TM 515 MAINFRAME Calibration package, like new, late color. Includes 1 PG 506 calibration generator, 1 TG 501 time mark generator, 1 SG 503 signal generator and 1 SG 504 signal generator. \$4500.00	TEKTRONIX 475 Portable Oscilloscope, 200 MHz bw, dual trace, 2mV/div sensitivity, 1 nS/div sweep rate, delaying timebase, trigger view, and beam finder. \$925.00	
HEWLETT-PACKARD 8568B Spectrum Analyzer operates over a 100 Hz to 1500 MHz range, amplitude measurement range -135 dBm to +30 dBm, direct plot capabilities, fully programmable via HP-IB.  \$19750.00	TEKTRONIX 492 Spectrum Analyzer, 50 kHz to 21 GHz, 80 dB dynamic range, digital storage, option 02 adds digital storage.  \$7750.00	HEWLETT-PACKARD 1980B/ 1965A Oscilloscope Measuring System, DC to 100 MHz, fully HP-IB programmable. It features continuously-calibrated verniers, with 2 mV/div deflection factors and two independent 5 nS/div sweeps. The 1965A adds a fully programmable, 100 MHz universal counter to the 1980 system. \$1750.00
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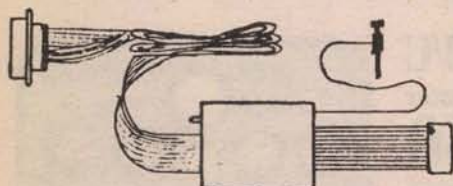
HAVE VICTOR 9000 with DOS 2.1. I need serial or modem comm program on Victor 9000 compatible floppy or info on converting or replacing floppy with DOS compatible drive. Kevin Eller, 14739 Poplar, Southgate, MI 48195. 313-284-4560.

INVENTORY BLOWOUT: Computer service business closes. Must sell hardware, software, test equipment/software. Call for list of items. 515-472-9586, FAX 515-472-8350.

BABY BLUE II CPM card (by Microlog), disk and manual only wanted. Also wanted: **WICAT 150** boot disk. KB6ZBD, 208-466-1931, 830 Briarwood Dr., Nampa, ID 83651.



8031/52BASIC CONTROLLER. 8/16/32/64K Selectable ROM. 8/32K Selectable RAM. RS-232. AC/DC 7-21V Power Regulator. 40 & 34-Pin System Signals Headers. Reset Switch. Development & Example Software. Bare Board \$16.25 Jocynda Rd., Flanders, NJ 07836. 201-584-3973 Andre.



EPROM EMULATOR. No unplugging or disconnecting during 11 second transfer thru parallel printer port. Includes cables, IBM disk. Supports Intel Hex, Motorola S and binary files. Multiple emulators support 16/32 bit/buss. 2764-27256 Emulator, \$109. Upgradable anytime to 2764-27512 for additional \$24. 100 ns access. 4.5 x 3.25 x 0.9" plastic case. \$5 shipping. Texans add 8.25% tax. LOGICAL DESIGN TOOLS, 5403 Everhart, Box 55, Corpus Christi, TX 512-855-6406.

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TR-325	Recharge Kit for PC-10/12/14/20/24/25 copier.	\$25.50
TR-370	Recharge Kit for Sharp Z-50/55/70 copier.	\$34.95
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9730	250 grms of high quality black toner for SX.	\$12.50ea/10
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8057	150 grms of high quality black toner for PC.	\$10.95ea/10
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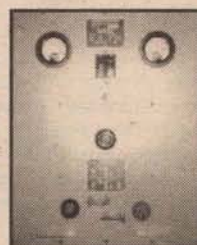
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POWER SUPPLY — \$130.00 (Volume discounts)
This military surplus power supply (PP-1104C/G) is new, and still in the box. It comes with the manual and is ideal for maintenance shops as a general purpose low-voltage dc power source. It converts 115 or 230V ac to 14 or 28V dc, up to 100 amps.



MULTIMETER — \$25.00 (Volume discounts)
This military surplus Multimeter (TS-352B/U) is still in the box with the manual. It is ideal for applications requiring 0 to 1000V ac and 0 to 5000V dc measurements. This is a real workhorse.

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Nuts & Volts Magazine/July 1993

25

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JAN'93



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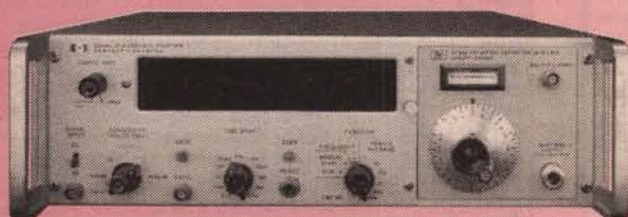
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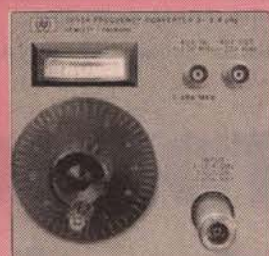
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ELECTRONICS & COMPUTERS



- Frequency range is from 0 to 3 GHz with the 5254C plug-in with an accuracy of ± 1 count \pm time base accuracy
- Period measurements from 0 to 1 MHz with an accuracy of ± 1 count \pm time base accuracy \pm trigger error
- Plug-in level indicator aids frequency selection and indicates useable signal level
- Ratio measurements 0 to 150 MHz
- Plug-in input voltage from 50 mV to 1 V at 50 Ω

HP 5248L/5254C
Electronic Counter System
\$595



HP 5255A
Frequency Converter
\$300

The HP 5255A Frequency Converter extends the range of the 5245L and 5246L counters from 3 to 12.4 GHz and can also be used as a direct counting prescaler from 1 to 200 MHz. The input voltage range is 100 mV to 0.7 V with an input impedance is 50 Ω with a type N (F) input connector.

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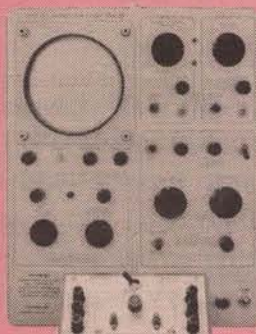
Military SG-677/U
Sweep Generator
\$349

- Solid-state sweep generator built to military specifications
- Provides RF signals from 500 kHz to 1200 MHz either swept or continuous wave
- Variable sweep width: 10 kHz to 1 MHz and 500 kHz to 400 MHz
- Center frequency fine tuning and front panel CAL adjust
- 0 to 70 dB attenuation in 10 dB steps; accuracy: ± 2 dB at any frequency
- Horizontal and vertical output connectors for oscilloscope or X-Y recorders
- Other features include: RF output meter, video input, RF detector input, RF detector output and external markers input
- Enclosed in utility/transit case but can be removed and rack-mounted



Tektronix 575
Curve Tracer
\$595

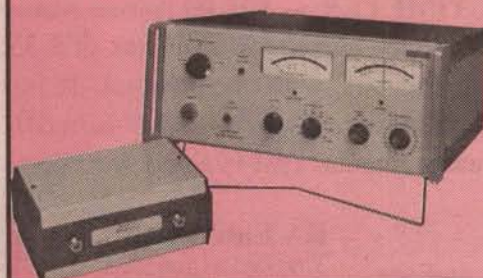
The popular Tek 575—Step Generator has voltage increments from 10 mV/step to 0.2 V/step and current increments from 1 μ A/step to 200 mA/step. Collector sweep generator offers positive or negative polarity and continuously variable peak sweep voltage (0 to 20 V with 10 A capability and 0 to 200 V with 1 A capability). Horizontal deflection factor (collector voltage) is 10 mV/div to 20 V/div, $\pm 3\%$. Vertical deflection factor (collector current) is 1 μ A/div to 1 A/div, $\pm 3\%$.



IN-HOUSE PROCESSING
25
TECHNICIANS ON STAFF

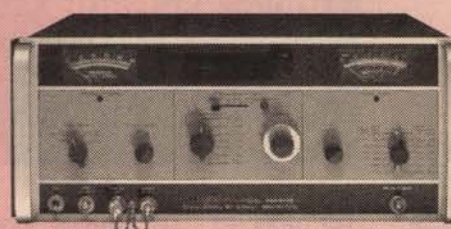
PRD 2020/2021
Vector Voltmeter System
\$995

Measures the amplitude and phase relationship of two RF voltages. Frequency range from 1.5 MHz to 2.4 GHz. Sensitivity is 1.5 to 200 MHz; -70 dBm and 200 MHz to 2.4 GHz; -65 dBm. Equipped with the 2021S2 Sampling Head.



HP 1720A
275 MHz Oscilloscope
\$995

The 1720A is a high performance oscilloscope with a 275 MHz bandwidth. For maximum measurement flexibility, the 1720A has a switch-selectable 50 Ω or 1 M Ω input. For general purpose probing, the 1 M Ω setting offers minimum circuit loading. The fully compensated 50 Ω setting provides full use of this oscilloscope's high bandwidth for pulse displays. Includes Delaying Timebase, Hold-Off, Scale Illumination, X-Y Display, Auto Focus and Intensity features. The 1720A comes equipped with 90-day warranty and operating manual.

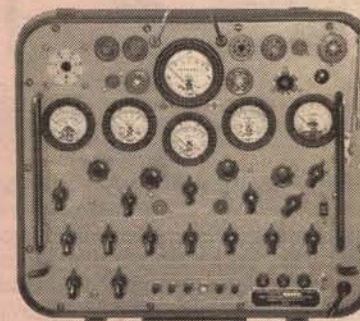


Logimetrics
925/S125
RF Signal Generator
\$695

The Logimetrics 925/S125 is a solid-state RF Signal Generator providing outstanding performance at an economical price. The RF generator supplies -127 dB to +23 dB from 50 kHz to 80 MHz (7 bands) and also has a vernier fine tuning, capable of controlling the frequency to 1 ppm! Frequency readout is provided on a 6-digit visual display with selectable resolutions of 10 kHz, 1 kHz, and 100 Hz on all ranges. RF amplitude output is monitored on three different scales, 0 to 1 V rms, 0 to 3 V rms, and -15 to +3 dB (referenced to 0 dBm, 50 Ω). This is a superb unit, quite capable of handling a wide range of applications.

Military TV2B/U
Tube Tester
\$350

Here is a portable tube tester that is both reliable and rugged. Designed for the military to quickly and accurately test a vast range of tube types, completely to handbook specifications. The TV2B/U is very easy to use and incorporates separate meters for percent, filament, grid bias, plate, screen and signal. We have limited quantities and they are selling fast, give us a call and reserve yours today!



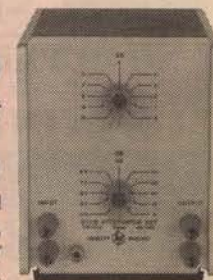
HP 141T/8552B/
8553B/8443A
Spectrum Analyzer/Tracking
Generator-Counter
\$3995

The HP 141T based spectrum analyzer features absolute calibration of frequency and amplitude, high resolution and sensitivity, wide dynamic range, and simple to interpret display output. The 141T mainframe features an easy to read 8 x 10 cm variable persistence CRT with a writing rate from 0.2 sec to 15 sec. Maximum storage time is over 2 hours at reduced brightness. The 8552B/8553B IF and RF sections feature a tuning range from 1 kHz to 110 MHz, with 18 calibrated scan widths from 20 Hz/div to 10 MHz/div in a 1, 2, 5 sequence. Amplitude range is from -140 to 10 dBm. Bandwidths are adjustable from 10 Hz to 300 kHz. The 8443A provides a tracking source with a range of 100 kHz to 110 MHz. Also has a built-in counter and RF attenuators to control output amplitude. Ideal for use with HP 8553B RF plug-in.

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HP 350D
Attenuator Set
\$95

0-110 dB attenuation in 1 dB and 10 dB steps. DC-1 MHz response, 600 Ω impedance, 5 watts power rating. Banana jacks.





Tektronix 132 Plug-in Unit Power Supply

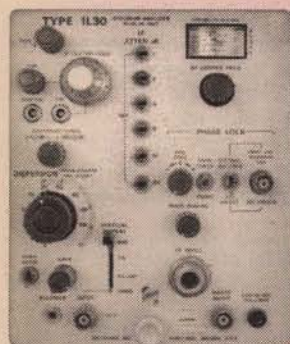
\$135

The model 132 provides a regulated power supply and amplifier for operation of Tektronix letter series plug-ins. This enables the use of many Tek plug-ins with or without a large mainframe scope. Frequency response of the amplifier unit is DC to 15 MHz. Both push-pull and single-ended output terminals are provided. Provisions are also made for dual-trace operation. If you are using letter or 1 series plug-ins, such as the Tek 1L-series analyzers, this is a must have unit. (Plug-ins sold separately)

Tektronix 1L20 Spectrum Analyzer Plug-In

\$449

- Operating frequency range of 10 MHz to 4.2 GHz
- Internal phase lock, calibrated dispersion to 100 MHz
- Resolution from 1 to 100 kHz
- Sensitivity of up to -100 dBm
- Fits 530, 540, and 550, or (with adapter) 580-series scopes



Tektronix 1L30 Analyzer Plug-In

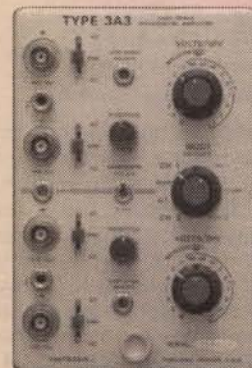
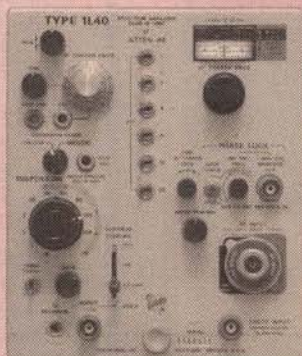
\$395

- Analyzer plug-in for use in Tek 530, 540, 550, or (with adapter), 580-series scopes
- Frequency range: 925 MHz to 10.5 GHz
- Bandwidth resolution: 1 kHz to 10 MHz/cm in 1-2-5 sequence
- Sensitivity: -75 to -125 dBm (1 kHz resolution); -55 to -85 dBm (100 kHz resolution)
- Built-in 51 dB attenuator; log, linear and square law display

Tektronix 1L40 Analyzer plug-in

\$650

- Covers 1.5 to 12.4 GHz, to 40 GHz with optional mixers
- Calibrated dispersion of 1 kHz to 10 MHz
- Bandwidth of 1 to 100 kHz
- 51 dB IF attenuator in 1 dB steps
- Maximum sensitivity: -95 to -10 dBm
- For use in 530-, 540-, 550-, or (with adapter), 580 Series Scopes



Tektronix 3A3 Dual-Trace Differential Amplifier Plug-In

\$65

- Designed for use in TEK 500 Series Mainframes
- FET Inputs
- DC to 500 kHz Bandwidth (all deflection factors)
- 100 μ V/div to 10 V/div (16 steps), continuously variable between ranges
- Display Modes: CH1, CH2, CHOP, and ALT
- Trigger Mode: CH1, CH2, COMP
- 50,000:1 CMRR
- Front-Panel Step Atten. Balance adjustments



Sony IPS-360 PYXIS Global Positioning System (GPS) Receiver

Price: List \$1199 Was \$899 Now Only

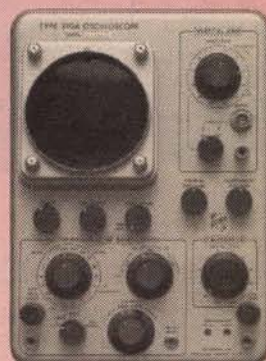
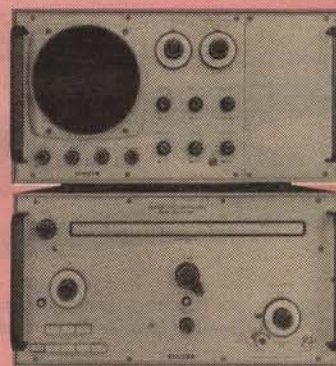
\$599

The Sony PYXIS GPS receiver fulfills the dream of navigators since the ancients: a portable, affordable, accurate way to fix your position by latitude, longitude, even altitude. To chart a course to your destination: determine your speed... check your time...and display a graphic picture of your progress - anywhere on (or above) planet Earth, at any hour of the day or night. Every control is simple, even for beginners. With simultaneous 4-channel satellite tracking, the accuracy of PYXIS information is astounding - position to within 30 to 100 meters. Detachable antenna and keyboard/display units can be mounted separately; supplied accessories include carrying case, mounting brackets, 12/24V DC adapter, stabilizing weight, carrying belt and antenna extension cable.

Singer SPA-3000 Spectrum Analyzer System

\$995

- Spectrum Analyzer with MF-100 Display and a Model RF-3000 Swept Front End
- 3 GHz dispersion with no in-band multiple responses up to 9 GHz; greater than 2 GHz dispersion with no in-band multiple responses from 9 to 40 GHz
- Built-in continuously tunable non-swept phase lock capability for narrow dispersion ranges
- Single push-button harmonic identifier switch for proper band selection
- Built-in RF and IF markers for self calibration and alignment
- Calibrated 60 dB on-screen log display with 1 MHz bandwidth for maximum dynamic range display of narrow pulse spectra
- RF sensitivities from -110 dBm for S+N=2N @ 1 kHz
- 1 MHz bandwidth for narrow pulse frequency and time-domain analysis
- Auxiliary outputs and inputs for remote plotting and programming



Tektronix 310A Oscilloscope

\$195

- Easy to use portable oscilloscope
- Bandwidth: DC to 4 MHz
- Vertical Deflection: 10 mV/div to 50 V/div (calibrated steps)
- Time Base is calibrated from 0.5 μ S/div to 0.2 S/div; x5 magnifier extends time base to 0.1 μ S/div
- 8 x 10 division CRT display area

Tek 454 \$595 Portable Oscilloscope

- Dual-trace
- DC to 150 MHz
- 0.05 μ sec to 5 sec/div timebase plus sweep delay circuit
- 5 mV/div sensitivity
- 6 x 10 div CRT



GRiDlite Laptops From \$349

These units are large by today's standards, but this is not necessarily bad. The GRiDlites, because of their size, have normal keyboards with standard typewriter spacing and the display is a 10" diagonal black/white LCD capable of 640 x 200 pixels (CGA). With 640 kB of memory and expandable EMS memory (optional) to 1 Mb, the GRiDlite with its 8 MHz 80C86 microprocessor can run virtually any of today's software. All units are configured with an internal clock/calendar and 25 pin serial port as well as a parallel, external peripheral and 9 pin external RGB monitor ports. All GRiDlites are supplied with an internal rechargeable NiCad battery and an AC power pack/recharger. Another great feature is the 10 MB and 20 MB units come with PC Master/PC Slave file transfer utilities and a file transfer cable, making transferring files from one PC to another, quick and easy! Physical characteristics: case is 3.1"H x 13"W x 11"L and made of high impact black plastic with a weight of less than 10 pounds.

Prices And Configuration
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XL with Floppy Drive Only	\$349.00
XL with 10 Mb Hard Drive Only	\$399.00
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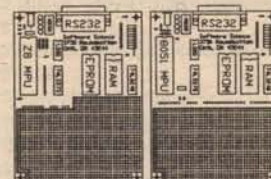
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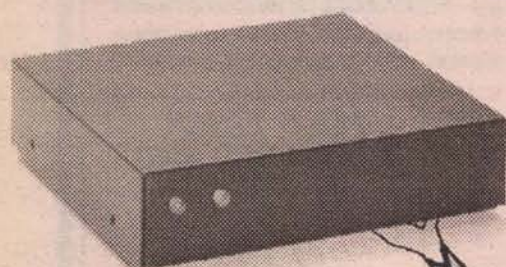
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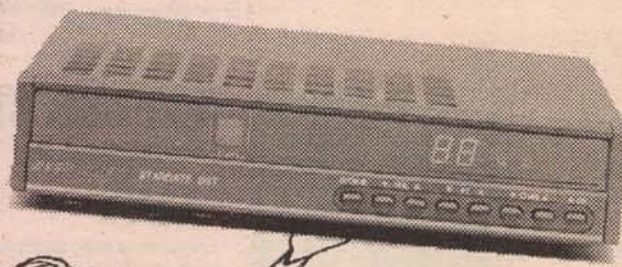
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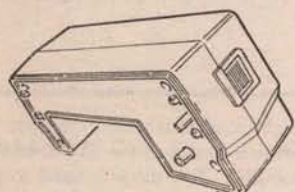
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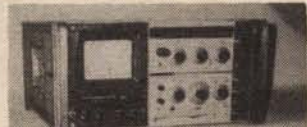
Vertical Sensitivity: 0.1mv to 20v/div. Band Width: DC to 500KHz. Input: Differential or single Banded, 1meg ohm, 45pf. Time Base: 1 microsec to 5 sec/division with a x10 magnifier. Trigger: Internal/External. Horizontal Sensitivity: 0.1v to 1.0v/div. Bandwidth: DC to 300KHz. Input: Single ended, 1meg ohm, 20pf. CRT: 8x10 cm. Calibrator: 1V. Size: 8-5/16"W x 11-3/4"H x 18-11/16"D. Wt: 34-1/2 lbs. Power: 115/230, 47 to 440Hz, 50 watts.



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STORM-MAN EMP Detector

by Nick Goss

**WITH THE STORM SEASON UPON US,
IT'S TIME TO BUILD THE STORM-MAN!**

You are sitting comfortably at your computer, working intently, completely oblivious to the approaching storm. Suddenly the image on your computer monitor swells, and with a sharp "crack" a fire-ball of lightning-induced plasma flashes out the back of your computer, television, stereo, and VCR! In one brief instant, thousands of dollars of electronic equipment are completely destroyed by a sudden lightning-strike to the power line. If only you had been warned of the approaching storm, you would have un-plugged everything, and potentially saved yourself from this disaster!

Every year thousands of computers, TVs, CDs, VCRs, etc., are completely destroyed by power line lightning-strikes. In addition to the electronic devastation, hundreds of people are killed and thousands injured by direct and nearby lightning strikes. Why not avoid at least some of the danger by building your own "early warning" system. Called the STORM-MAN, this month's project is as easy to build as it is fun to operate. Perfect as a family electronic project, the STORM-MAN will help protect you and your equipment for years to come. It doesn't matter if you live on a farm and wish to protect livestock, or are a housewife who is concerned about the safety of her children playing in the yard, or a serious experimenter ready to unlock the mysteries lightning stills holds, it's time to build the STORM-MAN!

MEET THE STORM-MAN

Basically, the STORM-MAN is an EMP (Electro Magnetic Pulse) detector. When lightning discharges from within a cloud, it produces a tremendously strong electromagnetic field that can often be detected over a hundred miles away. The Government uses devices similar to the STORM-MAN to help map lightning discharge across the country, and the Military uses a slight variation to detect the detonation of nuclear devices (fission/fusion weapons release massive amounts of electromagnetic energy). Although not as sophisticated and costly as some commercial units, your STORM-MAN is inexpensive and easy to build. So if you are ready to put together a unit for your home, shop or lab, let's get started!

CIRCUIT THEORY

Before we get started building your STORM-MAN let's look over the circuit theory. Begin by locating Figure 1, the STORM-MAN Circuit Schematic. Notice that diode D3, a 1N4148 signal diode, is coupled to the audio output of a standard AM pocket radio, through capacitor C1. By tuning your AM radio to an unused portion of the dial (>1500 KHz), you can "hear" the lightning (EMP) discharges as distant storms approach. In fact, you have probably been annoyed by how storms affect distant radio signals, and didn't realize that this same effect might be put to work for you!

Normally, when no storms are present, the audio input to C1 will be fairly constant, consisting of small amounts of low-level white noise. However, when a storm approaches, sudden releases of EMP energy cause AC spikes to appear at the anode-side of D3. These spikes and pulses are rectified by D3 and integrated in C2. The filtering effect of C2 helps dampen the effects of minor spikes and pulses, and minimize "false-alarms."

Resistor R2 provides a discharge path to ground for C2, and bleeds the energy stored in C2 slowly off to reset the circuit. IC U1 pins #1, 2 and 3 form a voltage-follower which precisely reproduces a buffered version of the signal at pin #3. The isolation-effect provided by IC U1 section 1 is important when driving the Differential Detector circuit formed by IC U1 pins #5, 6 and 7. As lightning strikes in the distance, the integrated EMP pulses are applied to capacitors C3 and C4. A current differential in the inverting and non-inverting inputs of the op-amp create a snap-action output at pin #7 of IC U1. Notice that the sensitivity control pot R5 provides C4 with a variable resistance to ground. As the name implies, this control will let you adjust the sensitivity of

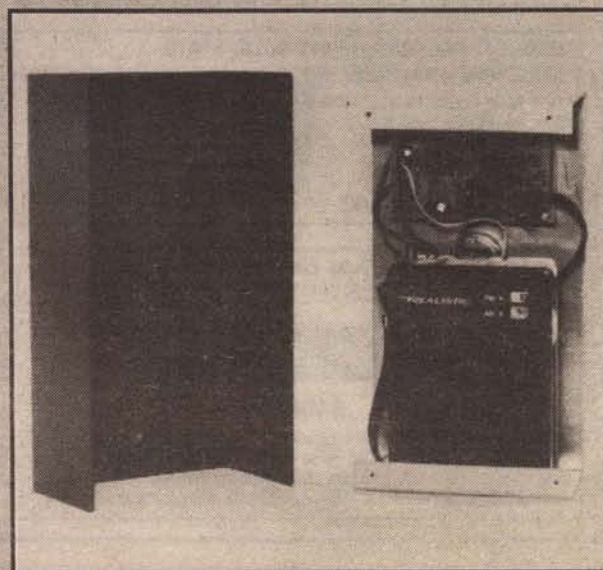


the STORM-MAN. In some cases, depending upon your installation site and location, the STORM-MAN will pick up man-made interference. R5 lets you compensate for these signals, and minimizes false-alarms.

As valid lightning-strike pulses are detected in U1 section 2, pulses are coupled through capacitor C5 and base/emitter current-limiting resistor R6, to Q1, a PNP signal transistor. Each time a negative-going pulse is applied to the base of Q1, the device will switch on, discharging timing capacitor C6. Because of the short duration of the discharge pulse, C6 will quickly recover by re-charging itself through RC time-constant resistor R8. The action of Q1 and its associated timing circuitry serve us by creating a "time-out" function which determines how long the STORM-MAN will sound an alarm. In this manner, as the distant storm approaches, we can judge how close and how severe the storm is by simply listening to how constant the alarm is! An occasional beep will sound as distant lightning is detected. However, as the storm moves closer, the beeping will turn into a constant warning signal, indicating just how severe the storm is. Conversely, as the storm-front passes over and begins to diminish, we will hear a corresponding change in the alarm beeping sound.

To create the beeping alarm sound, your STORM-MAN uses a special type of field effect transistor (FET) that has been optimized to operate as a low-voltage digital switch. As the collector voltage of Q1 rises above about 3 volts, Q2's Drain will begin to pull resistor R1 to ground. This grounding effect will switch the emitter of Q3 and associated sounder circuitry ON. Consisting of Q3, resistors R12, R13 and R14, and a Piezo sounder PZ-1, the sounder circuit produces a loud audio tone that can be heard many feet from the STORM-MAN. To further increase the effectiveness of the unit, IC U2, an NE555 timer/oscillator, is used to modulate the Piezo sounder tone, and to bias the RF section of the AM radio receiver. By heterodyning against the background noise at the receiver's frequency input, U1 is able to stabilize the STORM-MAN against unwanted periodic signals and spurious noises. Timing resistors R10 and R11, along with timing capacitor C7, set the astable frequency of the U2 oscillator circuit at about 10KHz. The switched output of U2 (pin #3) is applied to the collector of Q3, and completes the sounder drive-circuit.

To make your STORM-MAN unit as versatile as possible, an



external wall-type power supply module is used to provide 9 volts DC. This power supply voltage is routed to the STORM-MAN circuitry through steering diode D1. This diode is used to protect your STORM-MAN from an inadvertent reverse-polarity connection of the power supply module, and further, to isolate it from the standby battery power circuit. When wall power is lost, D1 will block battery power from returning to the supply. Similarly, diode D2 protects the standby battery from being constantly charged by the wall power supply. If you wish to use a NiCad battery, and maintain a trickle charge, you will need to add a series, current-limiting resistor to the circuit. However, I like to use an alkaline battery, because it is so seldomly used. Because the wall supply will be powering the pocket radio as well as the STORM-MAN, you will need to provide a 9 volt battery connector (as indicated) to snap onto the radio connector in place of a normal battery.

The basic STORM-MAN itself does not contain any form of surge-protection. You may want to consider adding a transorb or varistor to the power supply circuit if you plan to leave your STORM-MAN ON and unattended during storms. I prefer to unplug my STORM-MAN when a storm is near, and avoid any possible problem with a direct lightning strike; I recommend that you do the same.

STORM-MAN CONSTRUCTION

Building your STORM-MAN is fun and exciting. As simple as the circuit is, the STORM-MAN is perfect as a first-time project for young and old alike. (A great science-fair project as well!)

Begin construction by fabricating a printed circuit board from the full-sized artwork provided with the article. You can use any of the popular fabrication methods, or if you prefer, a pre-etched and drilled ready-to-wire board is available from the source listed in the Parts List.

I like to start with the passive components (resistors & capacitors), but you may want to start with the transistors or ICs. Use neat and careful work-habits, and stop to double-check your work frequently. A little extra time spent double-checking yourself now can save hours later looking for a part in the wrong place! Watch for cold solder-joints and solder-bridges. If you want to use a couple of 8-pin IC sockets, solder them into the PC board, and wait until later to actually install the chips.

Use Figure 2, the STORM-MAN Pictorial Drawing, to locate and place the various parts. When you have finished installing all of the parts, wire the sounder, potentiometer, push-button, power supply, battery leads, etc., into the holes indicated in the diagram. Double-check your work one last time, and then move onto the CHECK-OUT section.

TESTING YOUR STORM-MAN

Checking your STORM-MAN for proper operation is easy. After plugging the unit in, use a scope, voltmeter or DMM to check the voltages at several points around the card. Be sure that the supply voltages at IC U1 pin #8 is at or above +9 volts DC, and that U2 pins #4 and #8 are also at +9 volts or above. Next, connect your pocket radio to the STORM-MAN using a small 3.5mm ear-phone plug. If your radio does not have an ear-phone jack, simply connect C1 and GND across the radio speaker. Double-check your wiring of the radio battery clip for proper polarity BEFORE connecting it to your radio! When you are certain that the polarity is correct, switch the radio ON/OFF/Volume control to the ON position. Turn the volume control up slightly while listening to the speaker and the STORM-MAN. When you can hear

music or talking on the AM band, tune to a clear spot as high up on the band as possible. (I like to get above 1600KHz when possible.)

Next, adjust the volume of the radio and R5 until it keeps your STORM-MAN quiet. Then with the STORM-MAN sitting on a work table or surface, switch on a hair-dryer close to the unit. The EMP energy released by the hair-dryer should be enough to trigger your STORM-MAN. In fact, you will probably find that you have to turn your sensitivity control down quite a bit to keep the room lights from triggering the unit! You will need to find a happy-medium between the volume of the radio ear-phone output and the R5 pot. I like to set my radio volume control so that the cathode of D3 is about .1 Vpp with just the background noise present. Then, any EMP will cause a sharp spike that will easily trigger the STORM-MAN's detector circuit.

The final test and calibration of your STORM-MAN will have to wait, unfortunately, until the next thunderstorm. When it occurs, work carefully, and remember that lightning could strike your power-line at any time. Many people are injured and killed each year as they talk on the telephone and use electrical appliances during thunderstorms. Even the act of unplugging your electronic equipment at the first signs of an approaching storm carries some risk! With your hand on the electrical plug itself, you would be directly in the lightning's path during a direct power-line strike! This shouldn't scare you unnecessarily, just use good judgment and always respect the tremendous amount of energy that lightning-strikes release.

FINAL ASSEMBLY

With your initial calibration taken care of, it's time to place your STORM-MAN in its case. Although your STORM-MAN can be placed in almost any type of enclosure, I recommend the specially designed aluminum case sourced in the Parts List. It was specifically designed for the STORM-MAN and has an integral compartment for the battery, PC board and pocket radio. Use nylon spacers to mount the PC board assembly in the front of the case. Secure R5 in the front panel and add a suitable knob. Temporarily remove the 9 VDC power supply leads from the unit, and then run them through a rubber grommet located in the hole at the bottom of the case. Finish up by installing the momentary push-button and the Piezo sounder. I like to use a little Super Glue or 5-minute epoxy to hold the sounder in place. When you have re-tested everything and confirmed that everything is in good working order, secure the front panel to the back cover with four #4 sheet metal screws.

STORM-MAN

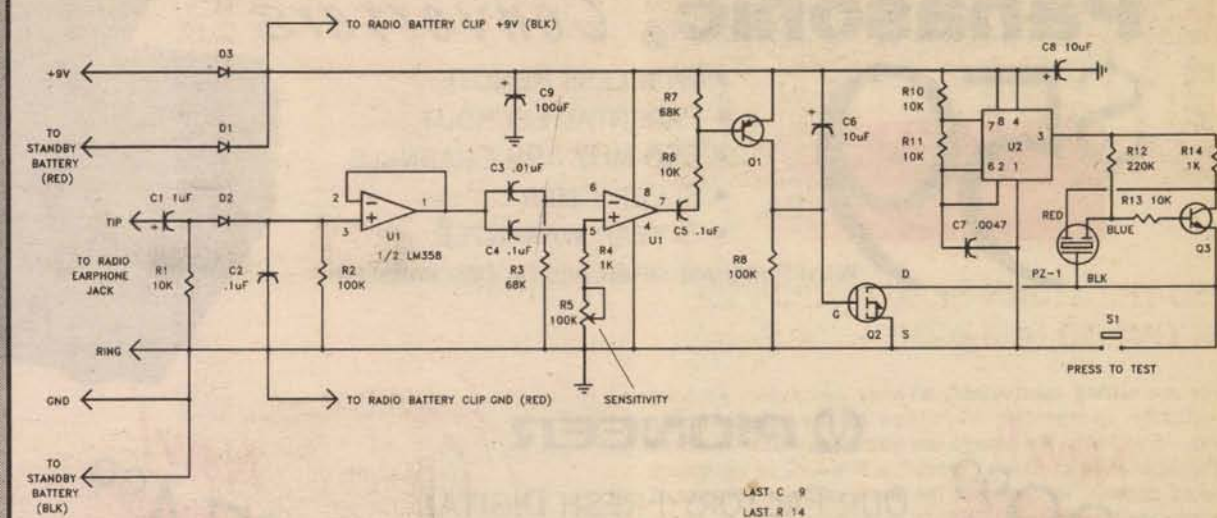
ALERT

SENSITIVITY

PRESS TO TEST

The STORM-MAN should be "wall-mounted" vertically. I like to keep my STORM-MAN in the lab where I work so it can be monitored easily. If you are using the STORM-MAN at home, you should probably consider placing it in the kitchen. When mounting it on the wall, probe the wall first with the pocket radio to make sure the location you have chosen is not hot from hidden electrical wiring. When you have found a suitable spot, use sheet metal or wood screws in the case slots to slide the STORM-MAN into place. When you place your STORM-MAN, be sure to factor in false alarms. Occasionally appliances (including microwave ovens) and car engines can set-off your STORM-MAN. You will get used to these false alarm situations, and learn what is a real alarm, as opposed to false signals.

Figure 1. STORM-MAN CIRCUIT SCHEMATIC



USING THE STORM-MAN

Using the STORM-MAN is automatic! When a distant storm first approaches you will probably hear a chirp now and then. As the storm grows in strength, or draws closer, the chirps and beeps will occur more often. Eventually, your STORM-MAN will sound its alarm continuously. This indicates a SEVERE CONDITION. Keep in mind that lightning is considered an "act of God," and is very unpredictable! In some instances, lightning can strike out of the blue, well in advance of the storm. These freak lightning occurrences can be devastating to the unprepared. For that reason, I begin to unplug electronic equipment at the first indications of an approaching storm. You will develop a feel for what that means as you gain experience with the unit.

There are several good Government publications (available from your local government agencies, as well as from the Federal Government and Weather Bureau) that detail good lightning safety practices. I encourage you to obtain them and review what you know about lightning. Mothers will probably want to call the kids inside at the first indications of local lightning. Open fields, and particularly single trees in open fields, are NEVER good places to be with lightning around. On farms, livestock can inadvertently gather under trees and along barbed-wire fences, both of which are certain lightning hazards. Being on a small boat in open water is also asking for trouble, as is talking on the telephone or touching anything electrical. I can distinctly recall watching a nearby lightning-strike induce enough energy in the chains of a cuckoo clock to form ball lightning and set the clock off! I'm sure glad I wasn't winding it!

Good luck with your new STORM-MAN. I hope that by building and using it, you will not only be warned at the earliest possible signs of lightning, but develop a new-found respect for one of nature's greatest spectacles! Be safe! NV

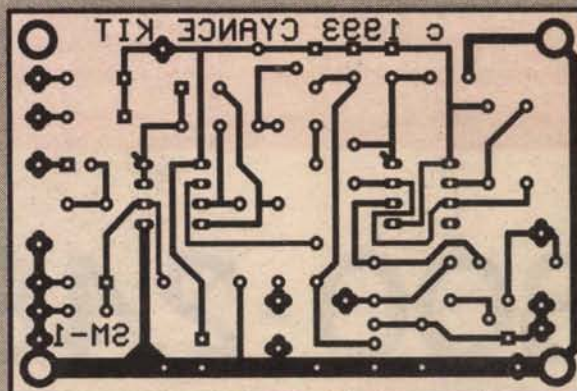


Figure 2. STORM-MAN PICTORIAL

PARTS LIST

SEMICONDUCTORS

Q1 MSA56 PNP Transistor
Q2 VN0300 HexFET (Silicon)
Q3 PN2222 NPN Transistor
D1,D2,D3 1N4148 Diode
U1 LM358 Dual Op-amp IC
U2 NE555 Timer/Osc.

RESISTORS (1/4w, 5%)

R1,R6,R10, 10,000 ohms
R11,R13 100,000 ohms
R2,R8 68,000 ohms
R3,R7 1,000 ohms
R4,R14 220,000 ohms
R12 100,000 1/4" pot
R5 Not Used
R9*

CAPACITORS

C1 1uF, 16-volt electrolytic
C2,C4,C5 .1uF, 50-volt mylar
C3 .01uF, 50-volt mylar
C6,C8 10uF, 16-volt electrolytic
C7 .0047uF, 50-volt mylar
C9 100uF, 16-volt electrolytic

MISCELLANEOUS

qty-1 printed circuit board, qty-1 STORM-MAN case with 4 #4 screws, qty-4 4-40x1/2" nylon spacers, qty-8 4-40x1/4" pan-Phillips head screws, qty-2 9 volt battery clip connectors, 2 feet #24 stranded hook-up wire, qty-1 3.5mm phone-plug, qty-1 three-wire Piezo effect sounder, qty-1 momentary SPST push-button, qty-1 1/4" control knob, qty-1 rubber grommet.

NOTE: The following items are available from CY-ANCE KIT, 14786 Slate Gap Rd., West Fork, AR 72774; (501) 839-8293 voice, or (501) 839-8221 fax. Pre-drilled, pre-fabricated, painted and silkscreened STORM-MAN case with mounting screws \$9.95. Pre-etched and pre-drilled "ready-to-wire" printed circuit board \$8.95. Complete kit of all parts to build the STORM-MAN (less pocket radio) \$29.95. Radio Shack pocket AM radios \$9.95 each. Please add \$4.85 insured UPS S/H. Call for free catalog of other high technology kits. Now over 70 kits!

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WITH GAL 6001
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GOOD FOR ALL SA-DF SYSTEMS.

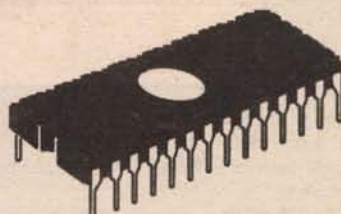
Also SA-3, SA-3B\$44⁹⁹



Test Kits

WITH INSTRUCTIONS

STARCOM 6\$25⁹⁹
STARCOM 7\$25⁹⁹
ZENITH\$16⁹⁹



8580 w/7 BUTTONS\$39⁹⁹
8580 w/6 BUTTONS.....\$24⁹⁹
TOCOM 5507 & 5503 . \$24⁹⁹

Original Factory Equipment

IN FULL TEST MODE WITH REMOTES



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TOCOM 5507\$259⁹⁹
JERROLD 400.....\$89⁹⁹
REGENCY 450\$89⁹⁹

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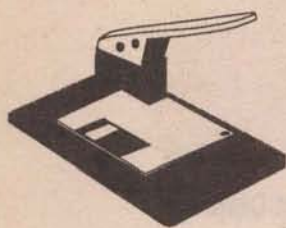
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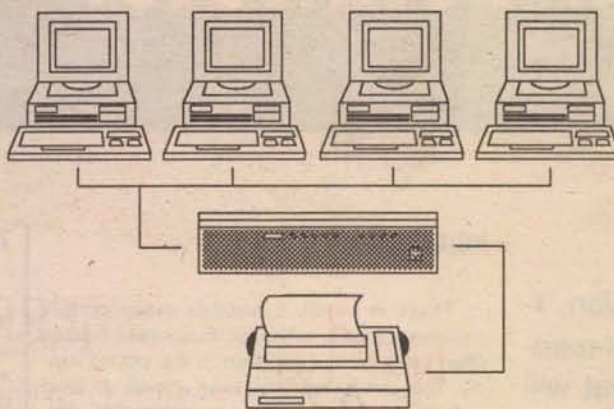
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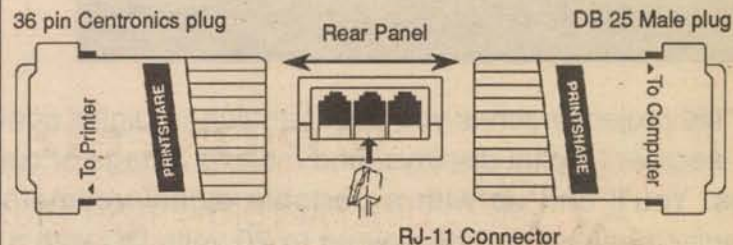
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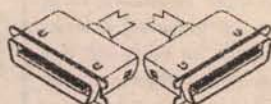
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Heavy duty cable and phone plug
Wind screen • Long battery life



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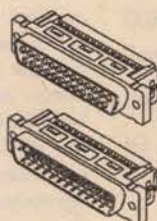
Centronics Cable 36 Pin Male to male



#CC-366 6 Foot \$3 each

#CC-MMC 10 Foot \$4 each

IDC Connector DB25 Male or Female



other sizes too!

#CN-554 Male \$1 each

#CN-555 Female \$1 each

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Molded • Shielded
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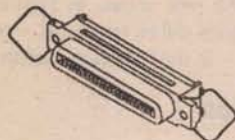
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50 pin Female
Grey with metal band



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BNC Terminators 50, 75, 93 Ohm

Please specify
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Fits large CRT's - feet separation up to 12" x 12"
Reduces glare, eye strain and neck craning
Elevates CRT for increased comfort
Fully adjustable

#TM-185 \$5.00 each 20 up \$4.00 each

Universal Printer Stand

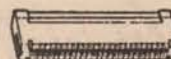
Totally Adjustable
Fits any desktop printer
Stores paper underneath
Deposits printout in tray
Saves space

#TM-183 \$5.00 each



IDC Card Edge Connector

34 pin Female



#CN-676

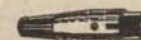
.50¢ each

20 up .40¢ each

100 up .35¢ each

XLR Connector

3 pin male or female



#CN-421 Female



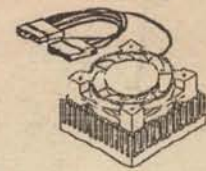
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Easy hook-up to power!
Clips to chip or stick to chip
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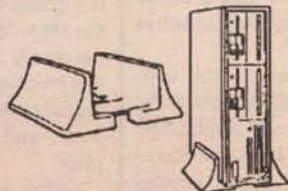


#TM-FAN-2

\$18 each 2 up \$16 each

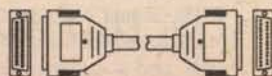
Universal System Stand

Saves space
Adjusts 4" to 7.5"
Hold unit vertically
Accommodates most units



#TM-181 5.00 each

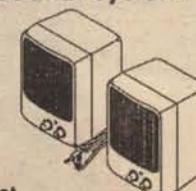
DB25 Cable 10 Foot • Male to Female Shielded • Molded • Thumbscrews



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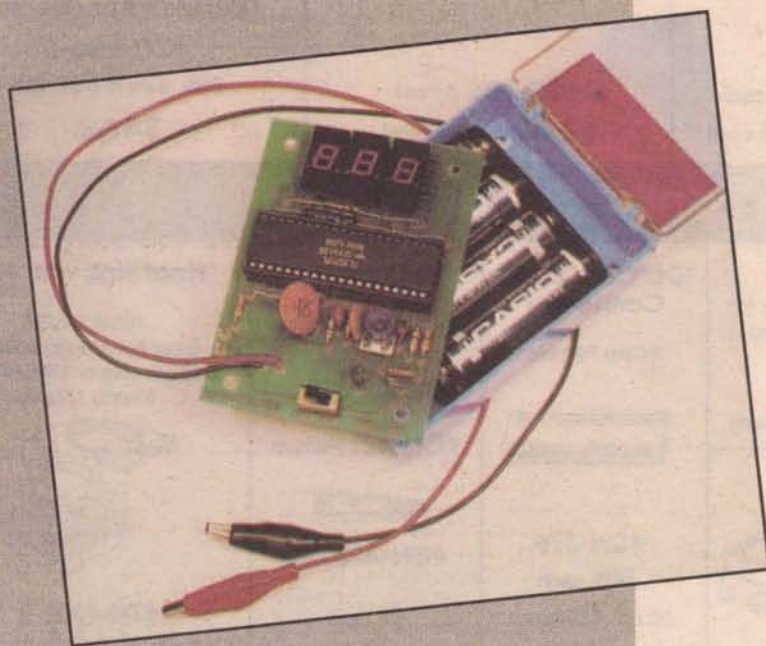
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Build a DC Digital Voltmeter

by Fred Blechman

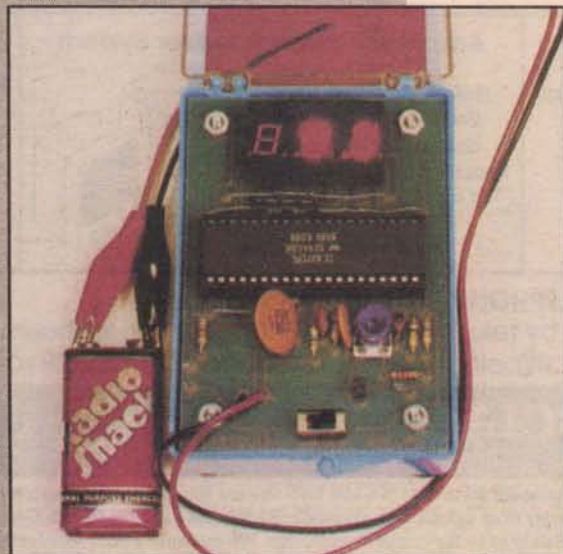
This project teaches you about analog-to-digital conversion, 7-segment digital displays, and making voltage or current readings. You'll end up with a portable digital voltmeter that will directly measure and display up to 20 volts DC with a resolution of .1 volts, well within the voltage range and resolution most common electronic products use. If you choose to make the modifications described, you can make a digital multimeter for measuring various ranges of DC voltage and current.

The schematic, basic theory of operation, and a complete parts listing are provided. All the parts and a printed circuit board are available as a Complete Parts Kit (including a case), as well as a Special Parts Kit of several special or hard-to-find parts. You can also build this project with parts you already have or can obtain from various suppliers that advertise in Nuts & Volts.



The batteries are in the bottom of the case.

With the case lid open, you can see all the parts. Measuring a 9-volt battery, the lighted digits blinded the camera in this time exposure.



Introduction

There is hardly a handier piece of test equipment than a voltmeter. Equipment failures often result from a problem in the power supply. This can be anything from a weak or dead battery to a failed diode or transistor. The cardinal rule of troubleshooting is to check voltages.

But you need a voltmeter to measure voltages, and there are several problems associated with this. If you use a common analog meter with a needle that swings up a scale, you should be aware that some such meters draw significant current when making their measurement, and can actually upset circuit operation. In effect, when you touch the meter probes to the circuit, you effectively create another circuit path for current to flow. The better analog voltmeters are rated at an input resistance of at least 20,000 ohms per volt (meaning it looks like 20,000 ohms resistance for each volt it is measuring). While a low input resistance is not significant when measuring voltage in high-current circuits such as in an automobile, it can have a significant effect when measuring typical consumer transistor or integrated circuit voltages.

Additionally, analog meters often have problems with fragility and accuracy. Most meters of this sort have a zero adjustment because frequent handling causes the delicate jeweled meter movement to get out of balance. Mistreat these movements badly enough and the needle will bend and stick, or the needle pivots will jam.

Also, some analog meters are hard to read, especially those with multiple scales. Some even have a mirror behind the needle so that you can eliminate the "parallax error" of looking at the needle from the side (and misreading the scale markings) instead of reading directly above the needle.

On the other hand, digital meters read numbers (no parallax error) and usually have the decimal point properly placed. Most digital meters also show a polarity sign in case you have the leads connected in reverse. Most importantly, the input resistance of most digital meters is somewhere around 10,000,000 ohms (10 megohms) regardless of the voltage being measured. This means digital voltmeters have virtually no effect on the circuit they are measuring.

The digital voltmeter described in this construction project has a 10 megohm input resistance, and is designed to read and display DC voltage from .1 to 19.9 volts in .1 volt increments. While this may seem like a limited range, most transistor, integrated circuit and automotive voltages are below 20 volts.

No negative polarity indicator is displayed, but can be easily added. For convenience and portability, this project is battery-operated, and four AA alkaline penlight batteries provide about 15 to 20 hours of continuous operation. Since no fragile moving needle movement is involved, this unit is relatively rugged. For those of you who like to experiment, later in this article I'll describe some changes you can make to add a polarity indicator, and read higher voltages or DC currents.

7-Segment Displays

Figure 1 shows the pin connections for the 7-segment LED (light-emitting diode) displays used in this project. These are "common-anode" displays, meaning each "segment" (lighted bar) is connected to positive voltage. Note that each segment has a letter designation — A, B, C, D, E, F, or G. In order for a segment to light, its pin must be connected to circuit ground, usually through a "driver" that consists of a resistor, or a transistor and its biasing resistors.

The combination of segments lighted at one time form a number. For example, light segments B and C for a number 1. Segments A, B, C, D, and G form the number 3. All segments together form the number 8. Get the idea?

These displays also appear to have a left and right decimal point. However, the actual displays used in this project have only the left decimal point connected internally.

A-to-D Converter

Figure 2 shows the heart of this design, the Teledyne TC807CPL 2-1/2 digit analog-to-digital converter. This 40-pin integrated circuit (IC) is designed to drive standard 7-segment LED displays WITHOUT external drive electronics. That is, the resistors and transistors normally needed to light 7-segment displays are provided INTERNALLY in this IC. This is a significant saving in parts. Although it would normally require 16 external transistors and up to 48 external resistors to light the 16 segments of 2-1/2 digits, they are not needed with the TC807CPL, since the necessary driver circuitry is built into the IC!

The operation of the TC807CPL is fairly complex, as reflected by the strange designations of some of the pins shown in Figure 2. Most of these functions will be explained — or at least touched upon — in the following section.

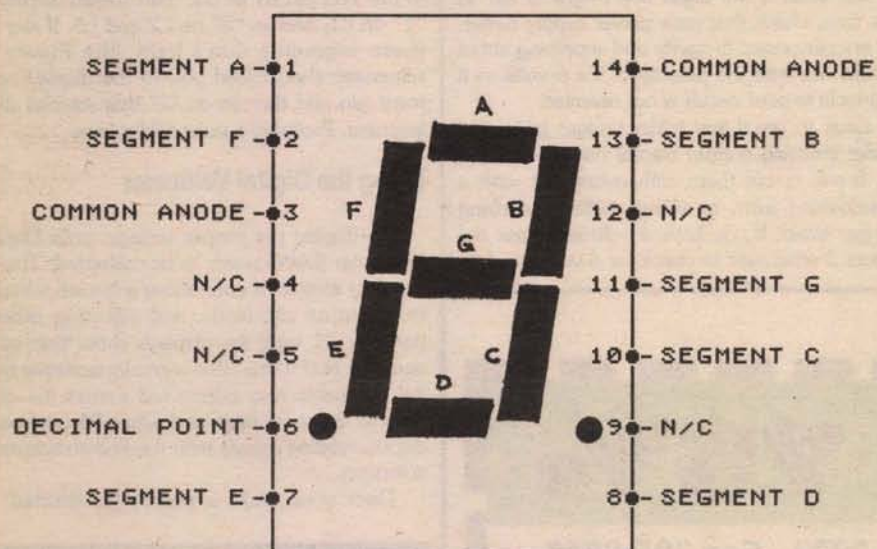
Circuit Operation

The schematic diagram of the 2-1/2 Digit Digital Voltmeter is shown in Figure 3. U1, the TC807CPL, is a 2-1/2 digit analog-to-digital converter. The left digit can only count to 1, the others can each count from 0 to 9 — hence the term "2-1/2 digit." This IC contains all the necessary internal circuitry to process analog input voltages, convert them to digital signals, digitally count up to 199, latch and decode the count, and drive the three 7-segment LED displays.

When switch S1 is closed, four AA alkaline batteries in a battery holder (B1) supply a positive 6 volts to U1, the TC807CPL IC, at pin 1, and also the common anodes of the three 7-digit displays, L1-L3. The negative side of B1 is connected to pins 26 and 21 of U1, power ground. Capacitor C1 acts as a battery voltage filter.

VR1 is a voltage regulator that provides a stable reference voltage for the internal A-to-D converter at pins 36 (positive) and 35 (negative.) Resistor R6 is used to limit the current through VR1. Resistor R7 and potentiometer P1 form a voltage divider to set the calibrating

FIGURE 1 – HP 5082-7730 DISPLAY OR EQUIVALENT



voltage at pin 36 of U1. Notice that pin 35, the V- Reference voltage, is connected back to the V- Input, pin 30 and Common, pin 32. This insures that the input voltage to be measured is compared with the stable voltage-controlled reference rather than the diminishing power supply voltage.

The DC voltage to be measured is applied to the input, with the positive applied to resistor R3, and the negative to pin 30. R3 determines the meter's 10 megohm input resistance. Capacitor C4 filters out any AC noise which might be riding on the DC input voltage.

R3 and R4 form a voltage divider that reduces the input voltage applied to pin 31 down to the input operating voltage required by U1 - 199 millivolts (.199 volts) or less. The ratio of R4 to (R3+R4) is 100,000 divided by 10,100,000, or .0099, or about .01. That means if you are measuring 15 volts at the input, 15 times .01, or .15 volts (which is 150 millivolts) appears between pins 31 and 30. The meter would read 15.0 when properly calibrated.

How does this conversion from analog to digital happen? Each measurement cycle is divided into three phases: (1) auto-zero; (2) signal integration; and (3) reference integration. The conversion rate is set by the clock oscillator frequency, which is controlled by capacitor C6 and resistor R5, connected to U1 pins 38, 39 and 40. Using these components, the conversion routine measures and displays about three times each second.

The first phase takes place at pin 29, using auto-zero capacitor C3 and IC internal gates to establish a zero-input condition. Next, signal voltage integration takes place for a fixed number of clock cycles as a charge accumulates on capacitor C2 (pin 27) proportional to the input voltage. At the end of the signal integration period, reference integration is accomplished by having C2 discharge through buffer resistor R2 and pin 28. An internal digital timer measures the discharge time back to zero; the longer it takes, the higher the original input voltage.

The digital timer count is then decoded into three 7-segment LED drive signals through pins 9-19 and 22-25. In effect, each segment that is to be lighted is grounded through U1 with the appropriate internal driver circuitry.

The L3 decimal point (pin 6) is always ON, with its cathode grounded through current-limiting resistor R1 and the negative side of the power supply.

For proper reference in most applications, capacitor C5 is connected between U1 pins 33 and 34. Pin 20 provides a negative-polarity

signal if the input voltage polarity is reversed; more on that later. Pin 37 provides a convenient test to see if all the display segments are correctly wired.

Construction

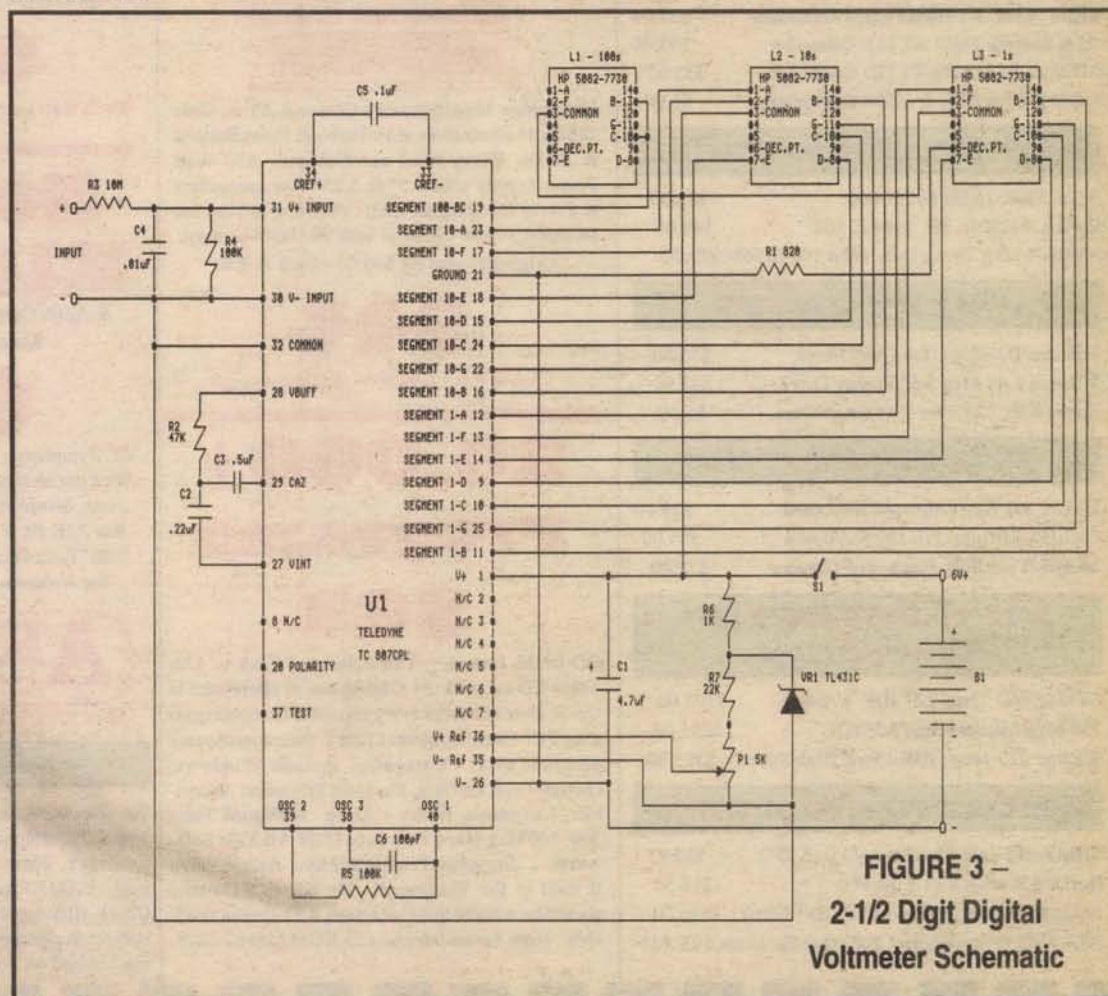
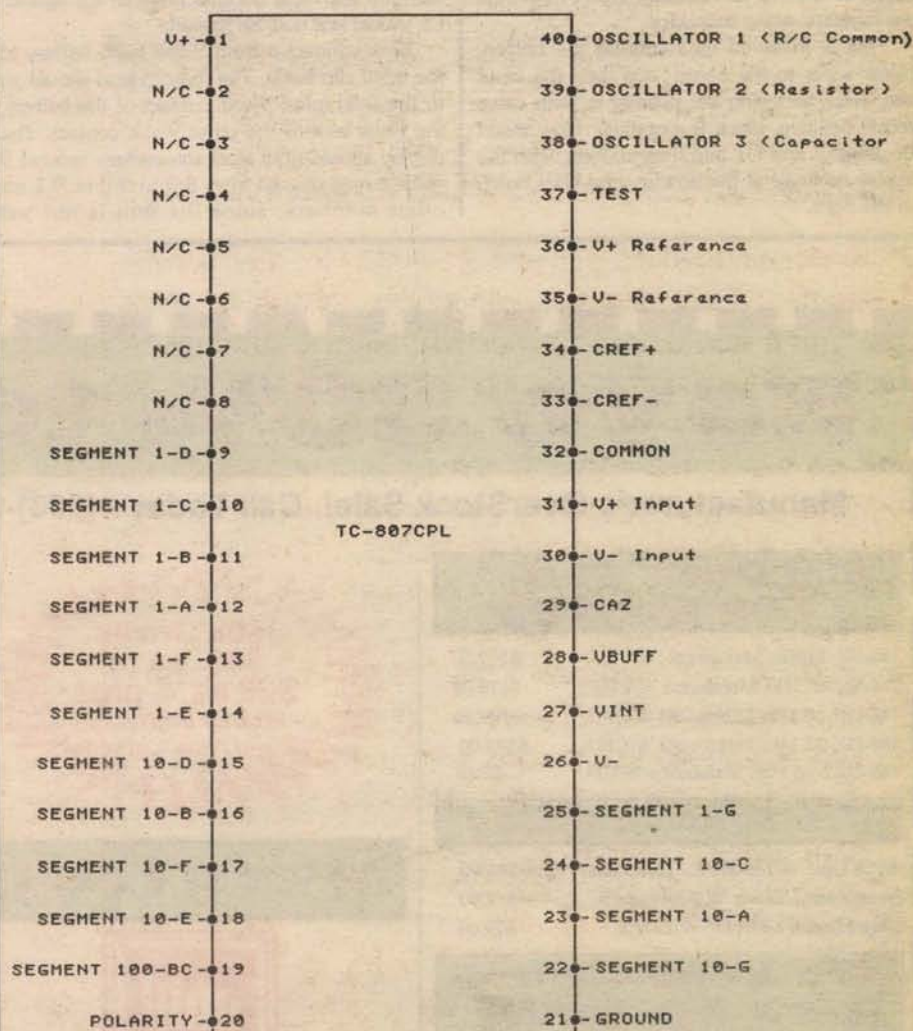
Because some of the parts used are special, or hard to find, the simplest way to build this project is to get the Cal West HK621BN Complete Parts Kit offered in the Parts List. This includes an etched and drilled printed circuit board (Figure 4) and all the required parts. A plastic case and mounting hardware are also included.

If you'd like to use parts you already have, or can get from Nuts & Volts or other vendors, you may want to order just the HK621SPBN Special Parts Kit that consists of the etched and drilled printed circuit board, Teledyne TC807CLP (very hard to find in single quantities), a 40-pin socket for the TC807CLP, the unusual TL431C regulator, and the special potentiometer and switch that mount in the printed circuit board. Since Cal West has a minimum \$10 order policy, the plastic cabinet and mounting hardware are available only with the complete kit.

Most of the parts, except those offered in the Special Parts Kit, are common parts. However, the 7-digit displays deserve further discussion. There are many similar-looking 7-segment displays available, especially from dealers that sell surplus items. You can substitute for the specified Hewlett-Packard HP 5082-7730 displays only if they are common anode displays with a left decimal point. If you use the printed circuit layout shown in Figure 4, you must also be sure the display pin connections are as shown in Figure 1, and that they will each fit in a 14-pin socket.

Figure 5 shows a pictorial of the assembly using the printed circuit board of Figure 4. Use a 25- or 35-watt soldering iron with a

FIGURE 2 – TC807CPL A/D CONVERTER PINOUT



small tip to avoid overheating the components or having solder flow between pins or traces where it shouldn't be. Assuming you use a printed circuit board, mount all components on the side of the board that does NOT have metal traces, and mount each part close to the board. First install and solder the resistors, then the capacitors (watch the polarity of C1), then the potentiometer, switch, voltage regulator (facing as shown), and sockets. Don't forget the two jumpers, using bare wire.

This is followed by soldering the battery holder wires to the board, and then the input lead wires, watching the polarity in both cases (red is positive, black is negative). Now insert the displays and U1 into their sockets, with the display decimals at the bottom, and U1's notch on the right.

Testing and Troubleshooting

Insert 4 AA alkaline batteries in the battery holder, making sure you observe battery polarity so the batteries are in series to provide a total of about 6 volts. Now turn on switch S1. After a short settling period during which L1 will probably display a "1" for a moment, displays L2 and L3 should each display a "0," with the left hand decimal point of L3 lighted. L1 should not now be lighted.

Now connect a fresh 9-volt radio battery to the input clip leads. The red clip lead should go to the solid (plus) 9-volt contact of the battery, the black lead to the other 9-volt contact. The display should now read somewhere around 9 volts. It may change from 8.9 to 9.0 or 9.1 (or other numbers, since the unit is not yet

calibrated) as U1 samples the voltage about three times each second.

Now reverse the clip lead connections to the battery, intentionally connecting the polarity "backwards." The readings should be the same! In other words, this digital voltmeter is not polarity dependent.

But what if the digits don't light at all? In this case, check that your power supply batteries are connected properly and supplying about 6 volts. Be sure the polarity of the 6 volts as it connects to your circuit is not reversed.

Look to see if any solder bridges (pieces of solder crossing copper traces) have formed. If so, break or cut them with cutters, or with a desoldering iron, or using solder-absorbing copper braid. If you have a voltmeter, use the Figure 3 schematic to check for 6 volts wherever

it should be. Be sure that U1 and the displays are plugged into their sockets in the right orientation, and that C1 and VR1 are not reversed.

If some display segments light, but others appear dead, connect a jumper wire from pin 1 of U1 (or the positive side of capacitor C1) to the Test pin 37 of U1. This should display a "1" on L1, and an "8" on L2 and L3. If any of these segments don't light, the Figure 3 schematic should lead you to the display segment pin and the pin on U1 that enables that segment. Probably a poor solder joint...

Using the Digital Voltmeter

To display the proper voltage, your Digital Voltmeter (DVM) needs to be calibrated. This is simply a matter of connecting a known voltage to the input clip leads, and adjusting potentiometer P1 until the displays show that voltage. It is best if you have a known-accurate digital voltmeter also connected across the clip leads at the same time, and adjust P1 until your display reading agrees with the known-accurate voltmeter.

Once your DVM is properly calibrated, it

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- C2 .22uF ceramic disc capacitor
- C3 .5uF ceramic disc capacitor
- C4 .01uF ceramic disc capacitor
- C5 .1uF ceramic disc capacitor
- C6 100pf ceramic disc capacitor

L1, L2, L3 - Hewlett-Packard 5082-7730 .3-inch 7-segment LED display, or equivalent (see text)

- P1 5K 1/2-watt potentiometer
- R1 820 ohm 1/4-watt 10% carbon resistor
- R2 47,000 ohm 1/4-watt 10% carbon resistor
- R3 10 megohm 1/4-watt 10% carbon resistor
- R4, R5 100,000 ohm 1/4-watt 10% carbon resistor
- R6 1,000 ohm 1/4-watt 10% carbon resistor
- R7 22,000 ohm 1/4-watt 10% carbon resistor
- S1 Single-pole single-throw (SPST) slide switch
- U1 Teledyne TC807CPL 2-1/2 Digit Analog-to-Digital Converter (see text)
- VR1 Texas Instruments TL431C voltage regulator

Miscellaneous: 3 14-pin sockets, 40-pin socket, 4 AA-cell battery holder, alligator clips, wire, solder. Optional: printed circuit board, plastic case, mounting hardware.

NOTE: The following items are available from **Cal West Supply**, 31320 Via Colinas, Suite 105, Westlake Village, CA 91362. Phones: (800) 892-8000 or (818) 889-2209. Minimum order is \$10, not including shipping. All orders in the Continental U.S.A must include \$3.50 shipping and handling per order. CA residents add 7.25% sales tax. Alaska, Hawaii and Canada must include 20% (minimum \$6) for shipping and handling.

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HK621SPBN - Special Parts Kit: printed board, U1, 40-pin socket, VR1, P1, S1 - \$10.70

will read voltages from .1 to 19.9 with good accuracy. Don't be alarmed if the digits flicker as the sampling is taken; some voltages vary by .1 or .2 volts as they are being sampled three times a second.

If you "overload" your DVM by connecting the input to a source greater than 1.99 volts, the last two digits (L2 and L3) will flash on and off, the over-voltage signal. I would avoid connecting the input to AC at all, or DC voltages above 30 volts. I don't know the limits, and I wasn't willing to destroy my DVM to find out!

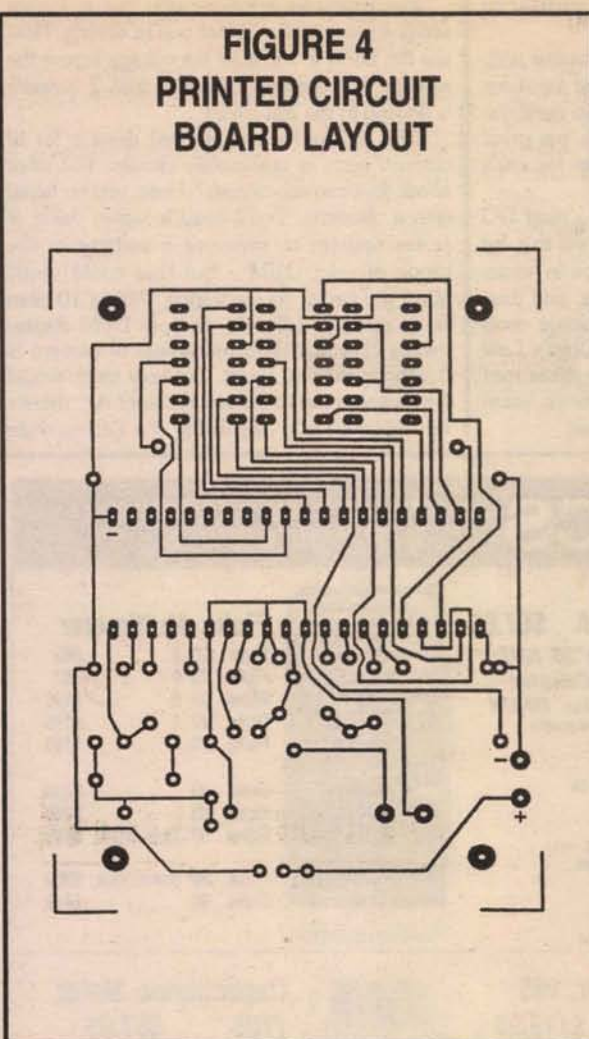
It is important that you note that the V-power ground and the V- Input ground are NOT the same. In other words, the input voltage to be measured is compared with the reference voltage, NOT the power supply voltage. For this reason, you can't measure its own power supply with this meter! If you try, you won't hurt anything; you'll just see a decimal point on L3, and a "1" displayed on L1, with L2 and the other segments of L3 apparently dead! This is also the reason you can't use this meter, without modification, to read car battery voltage if it's powered by the car battery.

Packaging

It is recommended that the DVM be mounted in a case. A metal, wood, or plastic case is usually used for this purpose. If you use a metal case, be sure none of the circuitry is in contact with the case. Cal West provides a 2-5/8" x 3-5/8" x 1-1/2" plastic case and hardware with their HK621BN Complete Part Kit. The printed circuit board fits perfectly in this case, which also has room for the battery holder under the printed circuit board. The mounting hardware includes screws, nuts, spacers, and rubber mounting feet.

Modifications

The easiest modification is to add a polarity

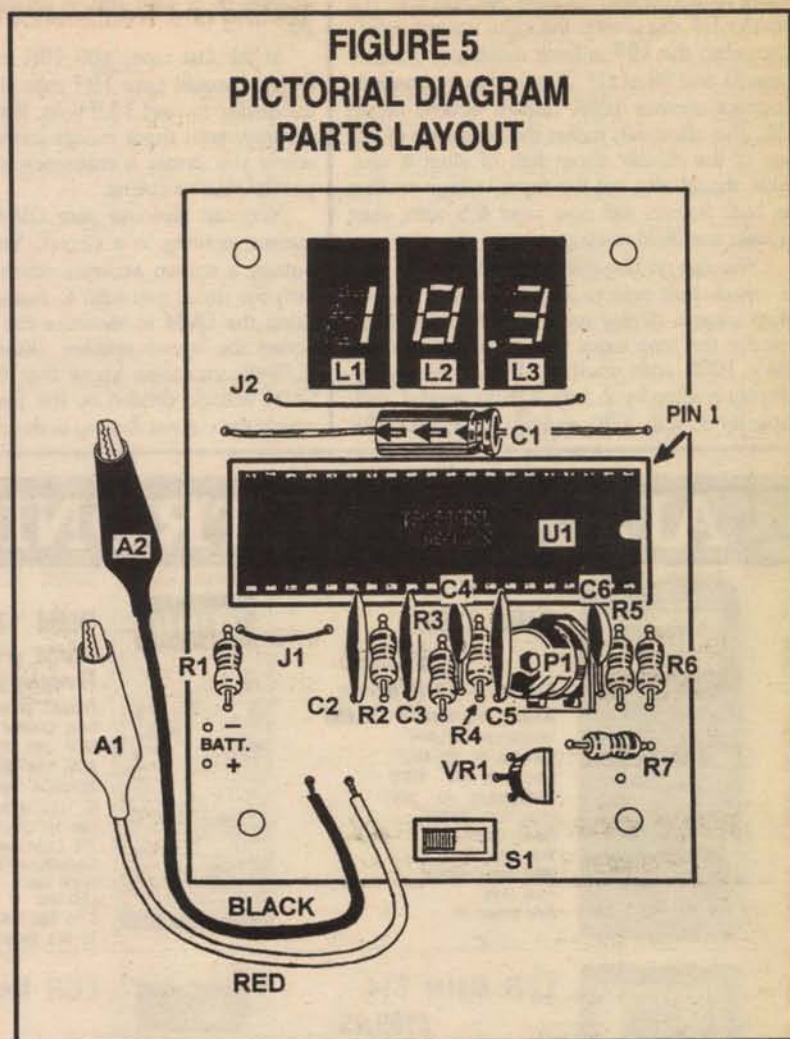


indicator. Just take a standard jumbo LED and connect the anode to positive 6 volt power, and the cathode (usually the lead at the flat spot on the LED base) to pin 20 of U1. Now

when you reverse the polarity of the input voltage, this LED will light. No current-limiting resistor is necessary. You could also use Segment G of L1 - not presently connected -

for this purpose; just connect pin 11 of L1 to pin 20 of U1.

If you'd like to read higher DC voltages, it is only necessary to change the relationship of



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input voltage divider resistors R3 and R4. The smaller R4, the greater the input voltage before exceeding the 199 millivolt maximum between pins 31 and 30 of U1. Just for fun, temporarily connect another 100K resistor directly across R4. This effectively makes the resistance of this leg of the divider about half of what it was. This should also cut the input voltage reading in half; 9 volts will now read 4.5 volts. Just double the DVM reading.

You can go hog-wild by paralleling R4 with a switch that selects various resistor values, then using a display reading multiplication factor for the true input voltage. If you parallel R4's 100K with another 100K, multiply the display reading by 2; with 47K in parallel, multiply by 3; with 33K, multiply by 4; with 22K

multiply by 5; with 10K in parallel, multiply by 10.

In this last case, with 10K in parallel with R4, you would have 199 volts at the input for the display to read 19.9 volts. Bear in mind the accuracy with these modifications is not great unless you create a calibration chart for each parallel resistor setting.

You can also use your DVM to read DC current flowing in a circuit. You do this by putting a known accurate resistance in series with the circuit you wish to measure, and then using the DVM to measure the voltage drop across the known resistor. Using Ohm's Law ($E/R=I$), you then know that the measured DVM voltage divided by the resistance value equals the current flowing in the circuit.

For example, suppose you put a 1-ohm series resistor in the circuit you're testing. Now use the DVM to measure the voltage across the resistor. If it displays 1.0 volts, then 1 ampere is flowing in the test circuit.

This is fine for circuits that draw a lot of current, such as automobile circuits. But what about low-current circuits? Here you're faced with a dilemma. You'll need a higher value of series resistor to measure a voltage in the range of your DVM - but that could easily affect the circuit you're testing. With a 10 ohm series resistor, 1.0 volts on your DVM display means .1 amps (100 milliamps) of current is flowing in the test circuit. But how much would flow without the series test resistor? Ah, there's the rub! I'll leave calculating the intermediate

series resistor values and display multipliers to those of you who plan on doing this experimentation.

Caveat

Don't expect this DVM to compete with the flexibility and accuracy of the typical 3-1/2 digit \$50 (or more) digital multimeter. It is entirely practical and useful for measuring DC voltages below 20 volts, and lends itself very easily to experimentation - from which you learn and have fun at the same time. Considering the low kit price of under \$20 (including shipping), this is an excellent buy! **NV**

Fred Blechman has written over 650 magazine articles and five books about electronics and microcomputers since 1961.

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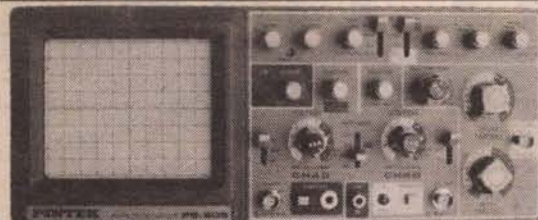


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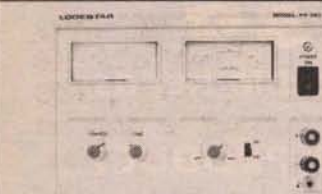
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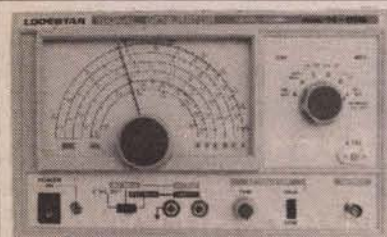
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Questions & Answers

QUESTION INFORMATION

TO BE CONSIDERED FOR PUBLICATION

All questions should relate to one or more of the following:

- 1) Circuit Design
- 2) Electronic Theory
- 3) Problem Solving
- 4) Other Similar Topics

INFORMATION/RESTRICTIONS

- No questions will be accepted that offer equipment for sale or equipment wanted to buy.
- Selected questions will be printed one time on a space available basis.
- Questions may be subject to editing.

HELPFUL HINTS

- Be brief but include all pertinent information — if no one knows what you're asking, you won't get any response (and we probably won't print it either).
- Write legibly (or type) — if we can't read it, we'll throw it away.
- Include your Name, Address and Phone Number — only your name will be published with the question, but we may need to contact you.

This is a **READER TO READER** Column. All questions AND answers will be provided by Nuts & Volts readers and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space available basis if deemed suitable to the publisher.

ANSWER INFORMATION

- Include the question number that appears directly below the question you are responding to.
- Payment of \$25 will be sent within three weeks of publication if your answer is printed.
- Only one answer per question will be printed.
- All answers submitted within a reasonable amount of time but **NOT** published will be forwarded to the reader submitting the question.
- If you do not want your name, address, or phone number available to the reader please so indicate or it will be assumed that you have no objection.
- In the event that more than one person submits the same solution, the choice will be made at the discretion of the publisher.
- Due to space limitations, we can not reprint the original questions with the answer. The question number and the issue it appeared in are printed above the answer.
- Unanswered questions from a past issue may still be responded to.

QUESTIONS

What kind of regulator can be used between a 12V to 24V battery supply and an electric DC motor to control the voltage and allow for a smooth acceleration? The batteries are regular 12V auto type and the regulator would have to handle approximately 25 to 30 amps at the lower end until motor was at top speed. I want an electronic type and not a reostat.

#7934
D. Schmidt
Walton, KY

I have a Heathkit Weather Station with computer output model. I would like to know if someone has written a Basic program to interface with either Commodore "64" or IBM "XT" to read and store weather data.

#79312
J. C. Carroll
Wrightstown, NJ

How can I modify an AM receiver to pick up SCA (Subcarrier Authorization) signals? There is a doctor's subscription SCA channel on standard broadcast AM across the country.

#79313
Peter Milone
Torrance, CA

How can I measure amperage from a bank of discharging capacitors (about 1/2 farad)? The pulse can range from 1000 to 6000 amps with a duration of 20 milliseconds. I would like to add a panel meter to a magnetizing unit I am building.

#79315
Ron Mason
Burnsville, MN

I would like a schematic or information on an analog delay line capable of delaying an audio signal for up to one second. It is to be used with an electric guitar.

#79316
Anthony Gillotti
Island Falls, ME

I recently constructed a +5-+25 VDC power supply for general use (regulated). I wanted to wire in a 3 pos. switch and meter to measure voltage out (pos. 2), and amps out (pos. 3). I used an old VOM circuit. My problem: Turning on the switch to activate the meter causes a current drop (both lowered voltage & higher resistance) that is significant in some cases. Enough so, that some applications cannot be adjusted accurately. Can this be corrected? How?

#79319
Michael Keller
Lancaster, PA

I need an infrared link that will plug into an RS-232 on back of a portable computer and talk with a TX receiver mounted on the ceiling. This is in turn attached to an RS-232 on a main computer. All transmissions will be indoors and up to approximately 40 feet in distance. The portable computer must be able to be moved while working.

#79320
Joel Lichtenwalner
Ogden, UT

I have a set of two voice scramblers made by Controlonics, model PD-101, but I can't get it to work without the proper connections that are supposed to be made on the front of the unit. These are jumpers that allow you to "program" the voice scrambler. I have the manual,

but it doesn't say anything about that. If anyone has any kind of information about these units, it would be great. Include the factory phone number if possible.

#79321
Rodrigo Santos
Somerville, MA

Where can I find the old 1 MB (Dip) chips for a PC-286?

#79322
Abe E. Oren
Phoenix, AZ

I would like to use a RBG + or - composite sync. monitor instead of a VGA monitor with my computer. I would like to know how to do this and a vendor who could supply the parts/cables. Also, I need to repair electronic circuit boards that have been vandalized by spraying salt water into them. These boards are used in soda vending machines and are for the dollar bill acceptor. If the salt water has a chance to dry, the traces become corroded. If you have any suggestions on how to clear the boards, please let me know. A friend of mine suggested using an ultra-sonic cleaner, which sounded very interesting.

#79323
Jay Stafford
Laurel, MD

What are the government controlled access frequencies restricted from over-the-counter scanners? What is the best scanner to interface with a computer?

#79324
Anonymous

June 8, 1993

I have a summer home 100 miles west of Chicago and have trouble picking up TV stations. I have a 35 ft. mast with rotor and would like to pick up Chicago channels. Have any ideas that wouldn't cost an arm & leg? I've tried boosters. I've been thinking of a dish or a new aerial. I would like to keep the cost under \$300. All I get is 2 channels, Quad Cities now.

#79325
D. Griffin
Hickory Hills, IL

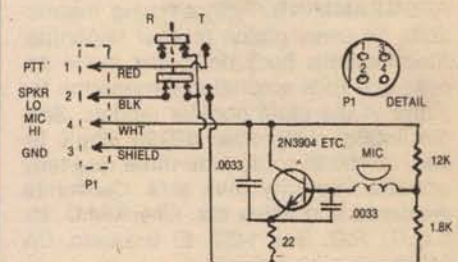
ANSWERS

ANSWER TO #59314 - MAY 1993

As Jan Aarup states, there is a circuit board in the microphone on Motorola CB model 4009 radio. The transistor circuit serves as a preamp and matches the impedance of the mic to the CB. The transistor is powered from an 8.2 volts regulated source through an 820Ω resistor in the CB and fed to the mic through the "Mic Hi" lead.

The circuit is not complicated and could be duplicated on a small piece of perf-board and installed in the replacement mic. The push to talk switch and the mic element should be connected as it was in the original Motorola mic.

Below is a schematic of the original mobile mic. The transistor can be an NPN general purpose such as 2N3904 ECG123AP or NTE123AP.



The Motorola Mocat CBs were good units. Good luck with the project.

Raymond Shetrone
Fort Myers, FL

Continued on page 108

COMMODORE 64 Ham Programs. 8 disk sides, over 200 Ham programs, \$16.95. 29¢ stamp gets unusual software catalog of utilities, games, adult, British disks. Home-Spun Software, Box 1064-H, Es-tero, FL 33928.

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8051 HACKERS AND DEVELOPERS. UltraMON51 is a firmware monitor program alternative to expensive hardware ICE and software emulators. Real time features include automatic baud rate detect, XMODEM data transfer to/from external RAM and code ROM, disassembly of code ROM, register/SFR examination/modification, internal/external RAM examination/modification, and much more. Don't let the low price fool you, UltraMON51 is a powerful tool! \$17.95 complete with docs, software, instructions on IBM 360K disk. Controlled Solutions, 7020 Grand Canyon Ste. 243, Austin, TX 78752.

PCB DESIGN software for Macintosh. McCAD PCB by VAMP, Inc., complete with original manual and updates; \$200. Also have Mac-to-Houston Inst. plotter cable. Mike, 2302 5th St. NE, Salem, OR 97303. 503-363-5143.

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CALENDAR

Continued from page 23

OH - COLUMBUS — Columbus Computer Fair. **LOCATION:** Radisson Hotel North, 4900 Sinclair Rd (just off I-70). **HOURS:** 10am-3pm. **ADMISSION:** \$4. **FEATURES:** C - DP. **DEALER INFO:** \$35 table. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

AUGUST 4-5-6-7

IL - ELGIN — Radiofest 1993. **SPONSOR:** Antique Radio Club of Illinois. **LOCATION:** Holiday Inn Holidome & Convention Center, 345 River Rd. **CONTACT:** Jeff Aulik, 1708 Parkview Ave, Rockford IL 61107. 815-399-1902 eves or wknds.

AUGUST 6-7-8

AR - LAKEVIEW — The 3905 Century Club Eyeball. **SPONSOR:** The 3905 Century Club, Inc. **LOCA-**

TION: Corps of Engineers campground on the shores of Bull Shoals Lake. **FEATURES:** DP. **CONTACT:** For information, send SASE w/ \$.52 postage to: Glen Van Rheeden, 608 Gentry, Mountain Home AR 72653.

AUGUST 7

IL - GRAYSLAKE — Lake County Computer Show & Sale. **SPONSOR:** EDI. **LOCATION:** Lake County Fairgrounds, Bldg. #2, Rt. 120 & Rt. 45. **HOURS:** 9am-3pm. **ADMISSION:** \$3, under 12 free. **FEATURES:** C - FP - F/R. **DEALER INFO:** Setup 7am. Booth 8'x10'. 8'x2 1/2' Tables: 1 = \$40, 2 = \$35 ea., 3+ = \$30 ea. 10% if paid 3 wks in adv. Free table for user groups, BBSs, Mac dealers. **CONTACT:** P.O. Box 73, Wadsworth, IL 60083. 708-680-7262, FAX 708-680-4141.

IN - INDIANAPOLIS — WA9SNT Hamfest. **LOCATION:** FTT Technical Institute, 9511 Angola Ct. **HOURS:** 8am-3pm. **ADMISSION:** \$1 adv. \$2 door. **TALK-IN:** 145.25. **FEATURES:** CB - DP - FM - F/R - RV-S. **DEALER INFO:** Inside 5' table/electric furnished \$5 plus door prize donation, outside flea market \$2 per space. Setup 6am. **CONTACT:** 317-875-8640.

AUGUST 8

IL - PEOTONE — Hamfesters Radio Club Hamfest. **LOCATION:** Will County Fairgrounds. **HOURS:** Gates open 6am. Exhibits 8am-3pm. **ADMISSION:** \$4 adv., \$5 gate. Under 12 free. **TALK-IN:** 146.52, 146.64, 146.94. **FEATURES:** AC - DP - FM - FP - F/R. **CONTACT:** David F. Brasel NF9N, 7528 W 109th Pl., Worth IL 60482. 708-448-9432.

IL - ROLLING MEADOWS — Midwest Computer Flea Market. **SPONSOR:** Midwest Shows. **LOCATION:** Rolling Meadows Holiday Inn, 3405 Algonquin Rd. **HOURS:** 9:30am-3pm. **ADMISSION:** \$3. **DEALER INFO:** 45 tables. 6' \$40. **CONTACT:** Midwest Shows, 8749 S. Harlem #197, Bridgeview IL 60455. 312-666-9500.

OH - PAULDING — 3rd Annual Hamfest. **SPONSOR:** Paulding County Amateur Radio Group, Inc. **LOCATION:** Paulding County Fairgrounds on Fairgrounds Rd. **HOURS:** 8am-7. **ADMISSION:** \$3, under 12 free with one adult. **TALK-IN:** 146.865/444.225+. **FEATURES:** CB - DP - EX - F/R. **DEALER INFO:** Setup 6am. Inside 8' table \$10 incl. one gate, outside spaces (20'x30') \$4 plus gate. **CONTACT:** PCARG, Inc., 14043 CR111, Paulding OH 45879. 419-399-3641/4507.

OH - RANDOLPH — Hamfair '93. **SPONSOR:** Portage Amateur Radio Club. **LOCATION:** Portage County Fairgrounds, St. Rt. 44, 3 mi. S of I-76. **HOURS:** 8am-4pm. **ADMISSION:** \$4 adv., \$5 gate. **TALK-IN:** 145.39-600. **FEATURES:** DP - F - FM - FP. **DEALER INFO:** Indoor tables \$8 ea., flea market space \$3 ea. **CONTACT:** Joanne Solak KJ30, 216-274-8240.

AUGUST 14

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Quality Inn East, 3525 N Shadeland, near 38th St. **HOURS:** 10am-3pm. **ADMISSION:** \$4. **FEATURES:** C - DP. **DEALER INFO:** No charge for User Group setups. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

WI - RHINELANDER — Northwoods Amateur Radio Club Swapfest. **LOCATION:** Sugarcamp Town Hall, Hwy 17. **HOURS:** 8am-3pm. **ADMISSION:** \$2. **TALK-IN:** 146.94, 145.43. **FEATURES:** EX - F/R. **CONTACT:** Glenn Woods N9GRF, 6569 Hillcrest Dr., Rhineland WI 54501.

AUGUST 15

IA - CEDAR RAPIDS — Summerfest '93. **SPONSOR:** Cedar Valley ARC. **LOCATION:** 5000 J Street SW. **ADMISSION:** \$4. **FEATURES:** AC - DP - EX - F - FM. **DEALER INFO:** Table rental \$11 ea. Contact Wayne Hughes, Attn.: Table Rental, 3109 6th St., Marion IA 52302. 319-373-2391. **CONTACT:** KEOMS, Wayne Harrah, 319-848-7481.

IL - QUINCY — Western Illinois ARC Swapfest. **SPONSOR:** Western Illinois Amateur Radio Club. **LOCATION:** Eagles Alps Lodge, 3737 N 5th St. **HOURS:** 8am-2pm. **ADMISSION:** \$2.50 adv., \$3 door. **TALK-IN:** 147.63/03, 146.34/94. **FEATURES:** T. **CONTACT:** Rod Simon N9MCX, WIARC, POB 3132, Quincy IL 62305.

MI - SAGINAW — Ham Radio Swap & Computer Fair. **SPONSOR:** Saginaw Valley Amateur Radio Assn. **LOCATION:** Saginaw Civic Center. **HOURS:** 8am-7. **ADMISSION:** \$3, \$2 adv. **TALK-IN:** 147.240. **FEATURES:** DP. **DEALER INFO:** Setup 6am. Tables \$10 adv., \$15 door. No trunk sales. **CONTACT:** SVARA Swap Committee, POB 1783, Saginaw MI 48605-1783.

OH - WARREN — Warren Hamfest. **SPONSOR:** Warren Amateur Radio Assn. **LOCATION:** Trumbull Branch Campus, Kent State University. **HOURS:** Flea market 6am-3pm, Inside dealers 8am-3pm. **ADMISSION:** \$4, under 12 free. **TALK-IN:** 146.37/97 & 448.00/443.00. **FEATURES:** AC - DP - EX - F - FM - FP - F/R. **DEALER INFO:** 8' table \$8, 10' flea market space \$3. **CONTACT:** Al Van Slyke N8IKX, 216-889-3378 OR Warren ARA Hamfest, POB 809, Warren OH 44482.

AUGUST 21

CO - DENVER — Computer Fair & Flea Market. **SPONSOR:** R and L Computer. **LOCATION:** Holiday Inn, 4849 Bannock. **HOURS:** 9:30am-2:30pm. **ADMISSION:** Free. **FEATURES:** C. **DEALER INFO:** Tables \$15 ea. 8:30am setup. **CONTACT:** 303-666-0878.*

MI - WESTLAND — Great Lakes Computer Show & Sale. **SPONSOR:** Progressive Computer Productions. **LOCATION:** Wayne-Ford Civic League, 1645 Wayne Rd, 1 blk S of Ford Rd next to Paddy's Pub. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4, Seniors/Students \$3, under 12 free w/adult. **FEATURES:** C - DP - FP - F/R. **DEALER INFO:** 8' \$25 ea, 12' \$35 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave., Ste 237, Dearborn MI 48124. 313-425-9276.

AUGUST 21-22

NM - ALBUQUERQUE — Duke City Hamfest/ARRL Section Convention. **SPONSOR:** The Duke City Hamfest & associated clubs. **LOCATION:** New Mexico Army National Guard Armory, 600 Wyoming Blvd. NE. **TALK-IN:** 147.10 (+600). **FEATURES:** DP. **CONTACT:** The Duke City Hamfest, POB 6552, Albuquerque NM 87197-6552.

AUGUST 22

MO - ST. CHARLES — St. Charles ARC Hamfest. **SPONSOR:** St. Charles ARC. **CONTACT:** Eric Koch NFOQ, 2805 Westminster, St. Charles MO 63301.

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communications receiver to monitor sub audible tones.

CALENDAR

OH - MARYSVILLE — Marysville Hamfest & Computer Show. **SPONSOR:** Union County Amateur Radio Club. **LOCATION:** Marysville Fairgrounds. **ADMISSION:** \$4 adv, \$5 gate. **TALK-IN:** 147.99/39. **FEATURES:** CB - EX - F - FM - RV-H. **DEALER INFO:** Flea market space \$5, inside space \$15, tables \$5. **CONTACT:** Don Sabins N8MGJ, 15704 Jolly Rd., Marysville OH 43040. 513-642-0475.

AUGUST 28

MN - ROSEAU — 7th Annual Hamfest. **SPONSOR:** Lake of the Woods Repeater Assn., Inc. **LOCATION:** Roseau High School Gym, Hwy. #11 E. **HOURS:** 10am-8pm. **ADMISSION:** \$11 adv. incl. banquet; \$5 adv. hamfest only. **TALK-IN:** 147.69/09 & 146.40/147.00. **FEATURES:** B - CB - DP - EX - FM - F/R - S. **DEALER INFO:** Setup night before or 8am. **CONTACT:** David Landby KB0HAP, Rte. 3 Box 10, Warroad MN 56763. 218-386-1092.

AUGUST 28-29

OH - DAYTON — Computerfest 1993. **SPONSOR:** Dayton Microcomputer Assn., Inc. **LOCATION:** HARA Conference & Exhibition Center, 1001 Shiloh Springs Rd. **HOURS:** Sat. 10am-6pm, Sun. 10am-4pm. **ADMISSION:** \$5.00 for both days. **FEATURES:** CB - FM. **CONTACT:** Bob Kwater, 1641 Bledsoe Dr., Bellbrook OH 45305-1350. 513-223-FEST.

AUGUST 29

MI - OWOSSO — ARRL Michigan State Convention. **SPONSOR:** Five County Swap & Shop. **LOCATION:** Baker College, 1020 S. Washington Ave. **HOURS:** 8am-7. **ADMISSION:** \$3 adv., \$4 after Aug. 18. **TALK-IN:** 147.02, 146.52. **FEATURES:** DP - F/R. **DEALER INFO:** Tables \$10 adv., \$15 after Aug. 18. **CONTACT:** Jan LaBrenz N8NSE, 1214 McKinley Ave., Bay City MI 48708. 517-893-3475.

SEPTEMBER 3-4

NM - ALAMOGORDO — 9th Annual Hamfest. **SPONSOR:** Alamogordo Amateur Radio Club. **LOCATION:** Otero County Fairgrounds, 3100 N. White Sands Blvd. **HOURS:** Fri. 3pm-9pm, Sat. 8am-2pm. **ADMISSION:** Free. **FEATURES:** AC - B - CB - EX - F/R. **CONTACT:** Bill Leehan N5SUM, 505-437-9781.

SEPTEMBER 4

OH - TROY — MCARC Hamfest '93. **SPONSOR:** Miami County Amateur Radio Club. **LOCATION:** Miami County Fairgrounds, 650 N. County Rd. 25A. **HOURS:** 8am-5pm. **FEATURES:** CB - DP - EX - F - FM - FP - F/R - RV-H. **CONTACT:** MCARC Hamfest '93, POB 214, Troy OH 45373.

SEPTEMBER 5

CO - COLORADO SPRINGS — Computer Fair & Flea Market. **SPONSOR:** R&L Computer. **LOCATION:** Holiday Inn, 3125 Sinton Rd. **HOURS:** 9:30am-2:30pm. **ADMISSION:** Free. **FEATURES:** C. **DEALER INFO:** 8:30am setup. **CONTACT:** R&L Computer Shows.*

IA - BURLINGTON — Burlington Hamfest '93. **SPONSOR:** Iowa-Illinois ARC Inc. **LOCATION:** National Guard Armory, Summer Street Rd. **HOURS:** 7:30am-3pm. **ADMISSION:** \$4 adv., \$5 door, under 12 free w/adult. **TALK-IN:** 146.790, 146.520. **FEATURES:** DP - EX - F - FP - F/R - H - T. **CONTACT:** Chuck Gysi N2DUP, POB 911, Burlington IA 52601-0991. 319-752-3000.

IN - INDIANAPOLIS — 4th Annual Central Indiana Hamfest/Computerfair. **LOCATION:** Indiana State Fairgrounds, East Pavilion Bldg. **HOURS:** 8am-3pm. **ADMISSION:** \$3 adv., \$4 door, under 12 free. **FEATURES:** DP - FP - F/R. **DEALER INFO:** Booths w/tables \$10 ea. **CONTACT:** 317-251-9833, 317-352-0136.

SEPTEMBER 6

MI - SOUTHFIELD — Michigan Computer Festival. **SPONSOR:** Computer Support Services. **LOCATION:** Southfield Pavilion, 26000 Evergreen Rd. **HOURS:** 10am-4pm. **ADMISSION:** \$4 seniors, \$3 students, under 12 free. **FEATURES:** CB - DP - F/R - S. **DEALER INFO:** Setup 7:30am-9:45am. 8' tables draped & covered. 1-4 tables \$35 ea., 5+ tables \$30 ea. **CONTACT:** Computer Support Services, POB 1350, Taylor MI 48180. 313-295-2237.

EASTERN REGION

JULY 3

PA - LEHMAN — Murgas ARC Hamfest. **SPONSOR:** Murgas Amateur Radio Club. **LOCATION:** Luzerne County Fairgrounds, Rte. 118. **HOURS:** 8am-7. **ADMISSION:** \$3 adv., \$4 gate. **XYL** & under 16 free. **TALK-IN:** 53.61, 53.81, 146.52, 146.61, 449.825. **FEATURES:** DP - EX - F/R. **DEALER INFO:**

Setup Fri. 2pm-9pm only. **CONTACT:** KA3A, 717-824-5724 days, 717-825-3940 eves.

JULY 3-4

NJ - CHERRY HILL — PC Dealer Showcase. **SPONSOR:** Star Ware. **LOCATION:** Cherry Hill Mall. **HOURS:** Sat. 10am-9:30pm, Sun. Noon-5pm. **ADMISSION:** Free. **FEATURES:** AC - FP - F/R. **CONTACT:** Star Ware 800-523-0702.

JULY 4

NY - SUFFERN — Rockland County Computer Fair & Sale. **LOCATION:** Holiday Inn, Exit 14B off NY Thruway. **HOURS:** 9am-3pm. **ADMISSION:** \$6 (\$5 after 1pm). **FEATURES:** C. **DEALER INFO:** 130 tables, 7am setup. **CONTACT:** Tri-State Fairs.*

PA - HARRISBURG — Harrisburg Hamfest. **SPONSOR:** Harrisburg RAC. **LOCATION:** Bressler Picnic Grounds. **HOURS:** 8am-2pm. **TALK-IN:** 6.76/R or

52/52. **CONTACT:** Steve Gobat KA3PDQ, 717-938-6943.

JULY 10

DE - DOVER — Computer Show & Sale. **LOCATION:** Dover Downs Racetrack, 1131 N Dupont Rd (Rt 13). **HOURS:** 10am-3pm. **ADMISSION:** \$6. **DEALER INFO:** 130 tables. Setup 8am. **CONTACT:** Tri-State Fairs.*

NC - SALISBURY — Firecracker Hamfest. **SPONSOR:** The Triple States Radio Amateur Club. **LOCATION:** Salisbury Civic Center. **HOURS:** 9am-4pm. **ADMISSION:** \$3 adv. & SASE, \$4 door. **TALK-IN:** 146.985. **FEATURES:** AC - DP - EX - FM. **DEALER INFO:** Indoor tables \$5, flea market free + admission. **CONTACT:** Walter (Alligator) Bastow N4KVF, 3045 High Rock Rd., Gold Hill NC, 28071.

SC - SUMMERVILLE — Charleston II Summer Hamfest & Computer Expo. **SPONSOR:** Trident Amateur Radio Club. **LOCATION:** Charleston Exchange Club

Fairgrounds, I-26 College Park Rd. & US 78. **HOURS:** 8:30am-2:30pm. **ADMISSION:** \$7 family, \$5 ea. **TALK-IN:** 147.27/146.52. **FEATURES:** C - EX - FM - FP. **DEALER INFO:** Flea Market tables \$8/\$10, dealers call. Setup from 6pm Fri. **CONTACT:** Charleston II c/o TARC, POB 73, Summerville SC 29484 or Scott WB3EFS, 803-572-9459.

JULY 11

MD - WESTMINSTER — Carroll County Hamfest & Computer Show. **SPONSOR:** Summit Amateur Radio Assn. **LOCATION:** Carroll County AG Center. **HOURS:** 8am-4pm. **ADMISSION:** \$5. **TALK-IN:** 145.41. **FEATURES:** EX - T. **DEALER INFO:** Tables \$10, \$20 day of show. Table info call N3DRB, 410-992-7745 5pm-10pm.

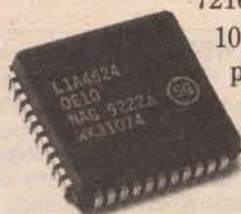
NH - PORTSMOUTH — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Frank Jones Center. **HOURS:** 10am-3:30pm. **FEA-**

Continued on page 56

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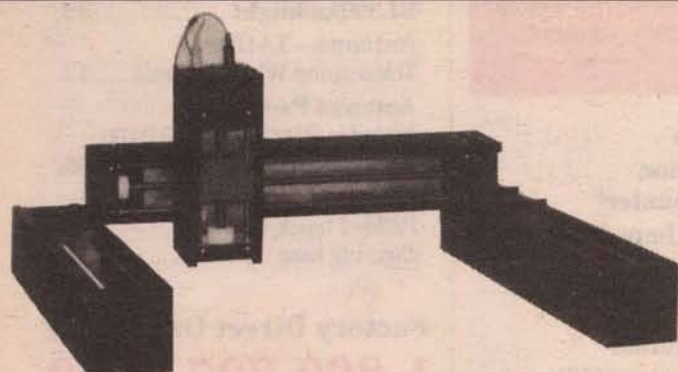
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DT-3

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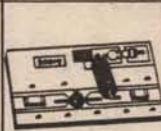
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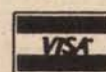


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3

Don Lancaster's

RESOURCE BIN

number eighteen

THE FURRY WITH THE SYRINGE ON TOP.

Our usual reminder here that the *Resource Bin* is now a two-way column. You can get tech help, consultant referrals and off-the-wall networking on nearly any electronic, *tinaja* questing, personal publishing, money machine, or computer topic by calling me at (602) 428-4073 weekdays 8-5 MST. I've got a free pair of insider secret resources brochures waiting for you when you call or write.

A portion of my PSRT RoundTable on *GENie* has also been set aside for you *Nuts & Volts* readers. This is the place to go for instant tech answers. Among the many files in our library, you will find complete reprints and preprints for all of my *Resource Bin* columns. I've just added a new "fast access" feature for you. Have your modem dial (800) 638-8369, followed by HHH. Then `XTX99005,SCRIPT`.

A free *GENie* brochure if you voice call (800) 638-9636.

I got my first look at *Silicon Chip*, an Australian magazine that is being sold in the U.S. by *Electronics Now*.

The best way to describe the style of this mag is "what *Modern Electronics* could have been with better editing." There's lots of construction projects here, including such heavy duty stuff as high power sinewave inverters.

On the other hand, this is the actual Australian magazine. With Australian ads and prices in Australian currency. Many small technical firms (my own *Synergetics* included) quickly discover that foreign sales and support often turn into a sucker bet. Thus, there are time and availability problems when responding to their ads.

But this is most assuredly a well done technical magazine with lots of understandable and hands-on stuff. It should be able to nicely fill the niche left by the U.S. demise of *Elektor*.

I apparently did miss bunches of ham radio magazines in our previous column. For openers, there's another Wayne Green mag called *Radio Fun*. Mostly for beginners. Then there's *DX Magazine* on long distance reception. And *Florida Skip*, a regional pub. Or that *Digital Digest*, a pub devoted to ham digital radio comm.

I suspect we may have a few more for you next month. Be sure to let me know about any I have missed.

• The Fringe

Any collection of resources has a *normalcy distribution*. Statisticians use a value called σ or *sigma* to measure where any smaller part of the whole belongs. For instance, the 1σ points include about 63% of the total. The 2σ points will include the next 63% of the remainder. And so on.

But there's some highly classified info the statisticians don't want you to know about. If you go out just beyond the 7σ point and look precisely at a location loosely defined by a

highly irrational and totally transcendental top secret magic number, you'll find "the zoo."

Look under your curve out at that magic 7σ zoo point, and you'll find *things* there. Stuff, even. A lot of which should be left totally unmolested. As Buckaroo Bonzai has said, "Don't touch that! No telling what it's connected to."

But if you are careful enough and brave enough, there is an incredible world to explore here. This month, I thought I'd brazenly guide you out beyond that 7σ point in our master *Synergetics* resource database. And see some of the wondrously bizarre items which constitute, for want of a better name, *the fringe*.

Let's start off with ...

• Archie McPhee

There is only one firm that begged to be included in our fringe listing. These folks freely admit to being a few chips shy of a full board. And are busy static damaging the few of their circuits that still function.

Archie McPhee, of course, who is the world's leading supplier of rubber iguanas. And lots of similar hacker and hobbyist essentials.

Their free catalog is a "must have." And is numero uno at the very top of our fringe collection.

• UFO Resources

I recently made a survey of UFO resources, and was astounded to find that this is an enormous industry with worldwide sales of tens of millions of dollars. A listing of the more major

teach their ET star wisdom, ET star paths, and ET stellar knowledge, as well as to bring the ET goodwill of stellar humanity to Terra 14 (Earth).

"The SSRL founders are the Benu (who is an actual ET from StarSystem Sirius) and Liah-Maiia GoldenHawk. Who is the Benu's Star Flame and Star Daughter.

"Members receive three newsletters, ET Planetary Origin Reading (which reveals the planet of origin), an ET Star Name, free Quartz crystal, a gold meditation key, the opportunity to learn directly from the Benu, your very own membership card plus the certification, and discounts on all the products offered."

"The Greater Square is their monthly newsletter for members. It offers the Benu's Stellar Messages."

They also publish *Solar Trek*, the ET Alien Quarterly Journal. Costs are \$25 for level 1 awareness, up to \$100 for your full level 4 access.

Hey really. Right on pages 41-42 of the second edition. Check it all out for yourself. There's 299 more where this one came from.

The UFO enthusiasts seem hung up on acronyms such as ICUFON.

Another fine UFO resource is Mike Sherlock, who's now in the process of editing down a video collection called the *UFO Marathon*. Mike also runs the *Black Range Lodge*, a unique, historic, and quite reasonably priced bed and breakfast type place tucked away in the most rugged and remote part of western New Mexico's outback.

By the way, I do have lots of secret escape places hidden quietly away in this neck of the woods. Most of them little known. For obvious reasons, I'm not going to list them all here. But you can give me a helpline call for a hint or two. Maybe more.

I might even join you.

Gurus are supposed to be hard to reach. Firstoff because it adds to the mystique, and secondly because the Gurus and Swamis Union Local #204 rules demand it. But we usually do welcome visitors and *tinaja* questors that call ahead.

• Free Energy

I sure do get scads of helpline calls over people seeking out "free energy." Which sounds kinda dumb to me. The desirability for unlimited free energy lies somewhere between Herpes and AIDS. Unlimited free energy would hasten the isentropic heat death of the planet. And would be a heinous crime against humanity.

At any rate, there are those of you out there who are free energy seekers. And there are purveyors of goods and services who will be more than glad to fill all your needs. Major resources here include *High Energy Enterprises*, *Borderland Research*, that *International Association for New Science*, *Amazing Archives*, *Lor'd*, and *Super Science*.

• Tesla

Nikola Tesla seems to draw in a strange crowd of latter-day followers. I'd guess the main problem here is that Tesla was a brilliant inventor and a superb con artist. Despite years of careful reading and study, I've yet to find so much as one credible shred of information that (A) Tesla was an ET alien; or that (B) Tesla energy devices violated the laws of thermodynamics; or that (C) Tesla's "really good stuff" got suppressed by a secret industry and gov-

ernment conspiracy.

There are a number of good sources for Tesla info which cover the broad spectrum from historical fact and the actual patents and papers. On down to outright hogwash. As openers, try the *Tesla Bookstore*, that *Tesla Society*, the *Tesla Coil Builder's Association*, or *Resonance Research*.

• More Miles Per Gallon

Lots of these guys advertise in the classified sections of *Popular Science*, *Popular Mechanics*, and all their clones. One unique source to check out here is *H&A Industries*.

• Steam Calliopes

Steam calliopes are becoming really hard to find. There's no good one-stop full-service supplier that I know of.

Ads sometime appear in *Amusement Business* magazine. *PAIA Electronics* once offered synthesized fakes. And *Live Steam* magazine ran a homebrew project a decade or so back.

But there is an outfit called *Ragtime* who custom creates air calliopes and orchestrans. They usually build these into older upright pianos. Prices vary with quality and craftsmanship. They have a beautiful \$5 catalog that gives full details on their products.

Somewhat related is *Always Jukin*, a newsletter for juke box collectors; the *Player Piano Company* which is also a great source for low pressure robotic pneumatics; that *Experimental Musical Instruments*; and, for those of you now building your own real pipe organs, the *Classical Organ Builder*.

• Synthetic Kale

I do sleep better at night knowing there are people out there who have dedicated their lives to perfecting synthetic kale. All the folks at *Garden Fresh Replicas* have done just that.

And they do take all their synthetic kale seriously. Genuine kale is used to make the molds, which are broken up after a few dozen impressions. After all, fake kale would look — well, *fake* — if it all was identical. And real kale is used for filler in all the replicas. The result is a product which is absolutely indistinguishable from the original. Except by taste.

• Grecian Urns

It never fails. It is 3 AM and you have this uncontrollable urge to write an ode. And there is no Grecian Urn anywhere in sight to write your ode on. What to do?

It's *Outwater Plastics* to the rescue. Who have got great prices and good delivery on the Grecian Urn replicas. They have also got a humongous free catalog chock full of unusual low cost metal and plastic hardware. Finials, too. And even plinths.

• Flying Cars

Gyro Gearloose is alive and well. You see, Gyro is one of my big heroes. Right up there with Scrooge McDuck himself, P.T. Barnum, William Gaines (who was the greatest philosopher of this century), Ed Abbey, Perry Ferrell, and, of course, Bucky Fuller. People real or imagined whom I model my life after.

Roadable Aircraft is a new newsletter about flying cars. Actually, we can't really call it an *unusual* pub. It's just your everyday plain old grunt M1A1 flying car magazine. And obviously well done as a labor of love.

For related publications, check out *Experimental Rotorcraft* and that older

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players appeared in HACK57.PS on *GENie* PSRT. On request, I'll throw in a free copy with any *Synergetics* order.

At any rate, there is a combined *Michelin Guide* and *Thomas Registry* to the UFO world. This is the *Almanac of UFO Organizations & Publications* by David Blevins. A listing of some 300 groups involved in the investigation of UFO phenomenon.

Let's extract a typical random entry from this great resource ...

"StarSystem Sirian Rainbow Lodge is mostly an ET Alien Outpost program, specializing in providing information from the alien point of view. SSRL is the only ET Teaching Lodge whose ET Teachings are actually taught by the ETs themselves.

"Their stated purpose is to assist humanity in the Stellar Awakening of Terra 14 (Earth),

Experimental Aircraft. A major source here is *Aircraft Spruce & Specialty*.

• Carnivorous Plants

And other things that go chomp in the night. Of all places, found inside the *Carnivorous Plant News*. Nuff said.

• Exotic Woods

We have seen how *EDLCO* is my favorite. But a brand new flyer from *Eisenbrand*

Hardwoods may have just what you need in the way of wenge, gonalco, shedua, or putu-mujo.

• The Mail Order Circle

There is this collection of rather scroungy and mostly-ads newsprint pubs that loosely refer to themselves as the *mail order circle*. Typical among the hundreds of participants are such titles as *Money Maker's Monthly*, *Mail Order Bulletin*, *Entrepreneur's Digest*, and

National Marketplace.

These mags are aimed at the reader that hopes to eventually be able to receive a chain letter.

Or has a wildly impossible dream of someday actually participating in a multilevel marketing scheme. These pubs are the primary home of those "Find out how I make money. Send \$19.95 to ..." ads. I'd bet the total collective IQ of their *entire* audience doesn't remotely begin to approach double digits.

I find these pubs totally fascinating. First because they are there. And also because good old P.T. "Don't miss the egress" Barnum in his wildest dreams would not have had the unmitigated gall to offer what these mags do.

These are useful because many of them are textbook perfect examples of how *not* to write ad copy, how *not* to spend advertising dollars, and how *not* to desktop publish.

The best way you can cheaply grab a great heaping handful of these all at once is through the *Select Information Exchange*. To me, they seem to be the definitive repository of ongoing cons and scams in the country today. And superbly good at what they do.

• Lindsay Publications

Lindsay is certainly unusual. Their big thing in life is reprinting ancient radio texts and turn-of-the-century machine shop information. Plus a full collection of hands-on books on just about any technical, pop science, or hobby subject. Often at very low costs.

Their free catalogs are keepers.

• Whole Earth Review

If something does seem truly and wondrously bizarre, the chances are pretty good it should sooner or later show up on the pages of the *Whole Earth Review*. This is the ongoing saga of Stewart Brand and all the original *Whole Earth Catalog* crew. They also sysop *The Well*, an innovative West Coast BBS. And are actually about to reissue a new WEC update.

• The World of Zines

There used to be a magazine called *Factsheet Five* who published scads of reviews. Underground, alternate ops, fanzines, fringe culture, small presses, and anything off the wall.

It is not at all clear to me whether *Factsheet Five* is still being published. But the best of the best (or the worst of the worst) has gotten released in book form as *The World of Zines*. "A guide to the independent magazine revolution."

Published by *Penguin Books* and in stock at many bookstores.

• Oddball Trade Journals

We have seen time and time again how the trade journals and specialty magazines are your key resource for picking up insider information in any field. There are over 70,000 magazines of this type in the U.S. alone. Many of these are free to qualified subscribers. The majority of them will send you a free copy if you use my secret SCAR sample-copy-ad-rates play.

Much more on all this can be found in my newly revised *Incredible Secret Money Machine II* and in the *Resource Bin* collected reprints.

The keys to the kingdom are on the reference shelf of your nearby library. *Ulrich's Periodicals Dictionary* is your best bet, while the *Standard Periodicals Guide* is a useful alternate that might be slightly easier to find.

A few examples: *Powder and Bulk Solids*

RESOURCES AT THE FRINGE

Aircraft Spruce & Specialty
PO Box 424
Fullerton, CA 92632
(800) 824-1930

Almanac UFO Orgs & Pubs
PO Box 1241
San Bruno, CA 94066
(415) 359-0432

Always Jukin
221 Yesler Way
Seattle, WA 98104
(206) 233-9460

Amusement Business
Box 24970
Nashville, TN 37202
(615) 321-4250

Black Range Lodge
Star Route 2, Box 119
Kingston, NM 88042
(505) 895-5652

Borderland Research
PO Box 429
Garberville, CA 95542
(707) 986-7211

Carnivorous Plant News
Fullerton Arboretum, CSUF
Fullerton, CA 92634
(714) 773-3579

Classical Organ Builder
PO Box 27476
Phoenix, AZ 85061
(602) 973-1395

EDM Today
1212 State Route 23
Butler, NJ 07405
(201) 833-3130

Eisenbrand Hardwoods
4100 Spencer Street
Torrance, CA 90503
(310) 542-3576

Experimental Aircraft
3000 Poberezny Drive
Oshkosh, WI 54903
(414) 426-4800

Experimental Musical Ins
1700 Old Rancheria Road
Nicasio, CA 94946
(415) 662-2182

Experimental Rotocraft
5555 Zuni SE #281
Albuquerque, NM 87108
(505) 298-9362

Foodservice Product News
104 Fifth Avenue
New York, NY 10011
(212) 206-7440

Garden Fresh Replicas
PO Box 208
Neosho, MO 64850
(800) 545-7304

H&A Industries
Rt 2, Box 35E
Bowling Green, MO 63334

High Energy Enterprises
PO Box 5636
Security, CO 80931
(719) 475-0918

Impressions
1515 Broadway
New York, NY 10036
(212) 669-1300

Int'l As for New Science
1304 S College Avenue
Fort Collins, CO 80524
(303) 482-3731

Lindsay Publications
PO Box 538
Bradley, IL 60915
(815) 935-5353

Live Steam
2779 Aero Park Drive
Traverse City, MO 49685
(616) 941-7160

Lor'd Indistries Limited
Box 156
Hancock, WI 54943
(715) 249-5611

Archie McPhee
PO Box 30852
Seattle, WA 98103
(206) 547-2467

Outwater Plastics
4 Passaic Street
Wood-Ridge, NJ 07075
(800) 526-0462

PAIA Electronics
3200 Teakwood Lane
Edmond, OK 73013
(405) 340-6300

Penguin Books
375 Hudson Street
New York, NY 10014
(212) 366-2000

Play Meter
PO box 24970
New Orleans, LA 70184
(504) 488-7003

Player Piano Co
704 East Douglas
Wichita, KS 67202
(316) 263-3241

Powder & Bulk Solids
PO box 640
Morris Plains, NJ 07950
(201) 292-5100

Printer's Devil
PO Box 66
Harrison, ID 83833
(208) 689-3738

Printwear
1008 Depot Hill Road
Broomfield, CO 80020
(303) 469-0424

Ragtime
4218 Jessup #AB
Ceres, CA 95307
(209) 668-0366

RePlay
22157 Clarendon Street
Woodland Hills, CA 91365
(818) 347-3820

Resonance Research
E11870 Shadylane Road
Baraboo, WI 53913
(608) 356-3647

Roadable Aircraft
338 8th Avenue South
Edmonds, WA 98020
(206) 778-0423

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244 West 54th Street
New York, NY 10019
(212) 247-7123

Skeptical Enquirer
PO Box 703
Buffalo, NY 14226
(716) 636-1425

Standard Periodicals Guide
150 Fifth Avenue #202
New York, NY 10011
(212) 741-0231

Tesla Bookstore
Box 121873
Chula Vista, CA 91912
(800) 398-2056

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Queensbury, NY 12804
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1180 Americas Avenue
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new dessert topping or an EPA approved grease trap clarifier.

A pair of fine desktop publishing magazines are *U&Ic* on typography plus Joe Singer's *Printer's Devil*. "A press in every home. A home in every press." Highly recommended.

Or the quarterly *Skeptical Enquirer*, authored by "name brand" scientists who try to debunk pseudoscience and the paranormal while using the very same manic religious fervor that their target subjects do.

• This Month's Contest

So, for this month's contest, just tell me about any good source for steam calliopes. Or tell me about anything else that deserves to be an important part of "all of the above." If possible, send me a copy or sample, or adsheet, or whatever. There will be some of my new

Incredible Secret Money Machine II books going to the dozen or so better entries, plus an all-expense-paid (FOB Thatcher, AZ) for two that will go to the very best of all. **NV**

Microcomputer pioneer and guru Don Lancaster is the author of 28 books and countless articles. Don maintains his no-charge tech helpline found at (602) 428-4073, besides offering all of his own books, reprints, and all of his consulting services. He also has a free brochure full of his resource secrets waiting for you. Your best calling times are 8-5 on weekdays, Mountain Standard Time.

Don is now the sysop of GENIE PSRT, where a special Resource Bin topic has been reserved for Nuts & Volts readers. For fast modem access, use (800) 638-8369 and enter HHH. When prompted, enter XTX99005,SCRIPT.

You can also reach Don at Synergetics, Box 809, Thatcher, AZ 85552.

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BOONTON 33A \$1,000, Boonton 72B \$250, GR 1633A \$2,000, PM 1018B \$500, Wiltron 610D/6225D \$2,500, Wilcom T207 \$250, Wilcom T195 \$300, Wiltron 9042 \$250. EF Electronics, Box 326, Aurora, IL 60507. 708-897-1950.

Nuts & Volts
430 Princeland Court
Corona, CA 91719
(714) 371-8497

Radio Fun
70 Route 202-North
Peterborough, NH 03458
(603) 924-0058

Silicon Chip
500-B Bi-County Blvd
Farmingdale, NY 11735
(516) 293-3000

Synergetics
Box 809
Thatcher, AZ 85552
(602) 438-4073

OTHER MENTIONED RESOURCES

Digital Digest
4063 N Goldenrod Road
Winter Park, FL 32792
(407) 671-0185

DX Magazine
PO Box 50
Fulton, CA 95439
(707) 523-1001

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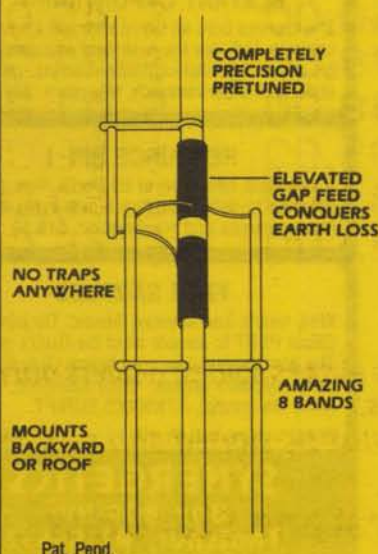
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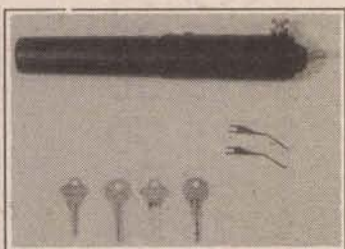
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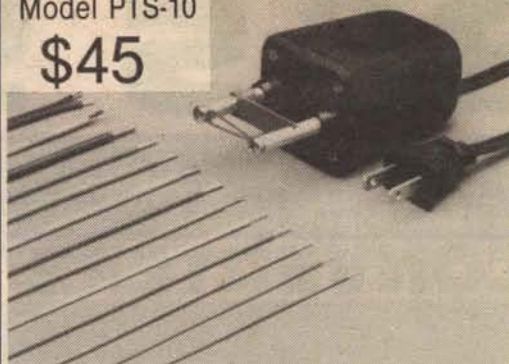
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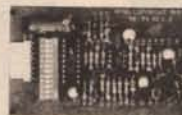
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TEST EQUIPMENT from Falkner Enterprises. Motorola R2001B/HS with spectrum analyzer \$2900. Motorola R2002B/HS with spectrum analyzer \$3500. Boonton AM-FM generator to 520MHz w/digital readout \$1500. Wavetek 3001 generator to 520MHz \$600. Tektronix 466 storage scope \$600. Motorola 100 watt dummy load 58B83464R01 \$75. HP8405A vector voltmeter, needs probe tip, \$490. HP334A distortion analyzer \$600. HP 435B power meter, needs new glass, \$300. HP 339A distortion analyzer \$1700. HP 331A distortion analyzer \$400. Tektronix 504 scope \$100. HP 353A patch panel \$100. Sony/Tektronix 308 data analyzer with probes \$900. Tektronix TM504 mainframe \$150. Tektronix WR501 with LA501 \$100. HP 400F AC voltmeter \$300. HP 3496A attenuator 10dB steps \$250. Biomation K100D logic analyzer, no probes, \$300. Biomation K100D logic analyzer for parts or repair \$100. Biomation K500D logic analyzer, offers. NIS Micro Analyst 2000 hardware/software system, offers. More items added weekly. Call or write for more current list. Non-working items are labeled as non-working in above list. Most items carry a 90 day warranty. Call or write for shipping charges. Iowa subject to state tax. Falkner Enterprises of America, Inc., 810 Broad Street, Sabula, IA 52070. 319-687-2479.

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HP 6253A	20V @ 3A Dual	HP 6291A	40V @ 5A
HP 6255A	40V @ 1.5A Dual	HP 6294A	60V @ 1A
HP 6259B	10V @ 50A	HP 6296A	60V @ 3A
HP 6260B	10V @ 100A	HP 6299A	100V @ .75A
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GR 1644A \$600, GR 1403A \$100, GR 1403N \$75, GR 1615P1 \$150, HP-182T \$1,000, HP-3581A \$1,000, HP-8445B \$400, PM 1009 \$150, PM 1038D14/H13/V12/V13 \$350, PM 1038D14A/N10 \$1500, Empire IG-115 \$350. E.F. Electronics, Box 326, Aurora, IL 60507 708-897-1950.

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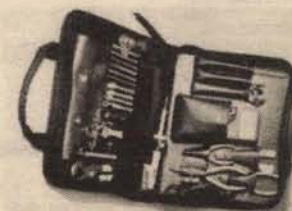
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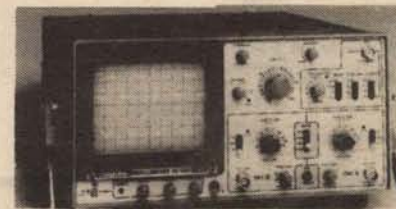
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120 MHz RECIPROCAL TECHNIQUE COUNTER/TIMER		
PHILIPS	PM8671-016	\$550.00
120 MHz/100 ns UNIVERSAL COUNTER/TIMER, GPIB		
TEK	7D15	\$300.00
225 MHz UNIVERSAL COUNTER/TIMER		
TEK	DC5004	\$475.00
PROGRAMMABLE COUNTER/TIMER		
TEK	DC5009/OPT.01	\$750.00
PROGRAMMABLE 135 MHz UNIVERSAL COUNTER/TIMER, TCXO		
TEK	DC5010	\$1,350.00
PROGRAMMABLE 350 MHz UNIVERSAL COUNTER/TIMER		
TEK	DC503A	\$500.00
125 MHz UNIVERSAL COUNTER/TIMER		
TEK	DC505A	\$250.00
225 MHz UNIVERSAL COUNTER/TIMER		
TEK	DC509	\$700.00
135 MHz HIGH RESOLUTION UNIVERSAL COUNTER/TIMER		
TEK	TVC501	\$800.00
TIME-VOLTAGE CONVERTER		
HP	3305B/5300B-001	\$450.00
1.3 GHz COUNTER PACKAGE WITH TCXO REFERENCE		
HP	5341A-003	\$550.00
1.5 GHz FREQUENCY COUNTER		
HP	5385A-004	\$1,200.00
1 GHz FREQUENCY COUNTER, W/HIGH STABILITY OCXO		
TEK	7D14	\$250.00
525 MHz FREQUENCY COUNTER		

AUDIO & BASEBAND

HP	3585A	\$6,000.00
SPECTRUM ANALYZER, 20 Hz-40 MHz, 3 Hz RES.		
HP	8556A	\$500.00
LF SECTION, 20 Hz-300 kHz		
ROCKLAND	5809A	\$1,000.00
FFT SPECTRUM ANALYZER, 0-100 kHz		
HP	331A	\$225.00
DISTORTION ANALYZER		
HP	4333A	\$875.00
DISTORTION ANALYZER		
TEK	AA501	\$1,850.00
DISTORTION ANALYZER		
TEK	DA4084	\$2,400.00
DISTORTION ANALYZER (AA5001 VARIANT, WITH POWER MODULE)		
HP	3581A	\$1,200.00
WAVE ANALYZER, 15 Hz-50 kHz		
HP	3586B	\$1,150.00
SELECTIVE LEVEL METER, 50 Hz-32.5 MHz, 75 OHMS		
BOONTON	93A	\$125.00
TRMS VOLTMETER, 10 Hz-20 MHz		
HP	3400A	\$175.00
RMS VOLTMETER, 10 Hz-10 MHz		
HP	3403C-001 006	\$450.00
TRUE RMS VOLTMETER, DC&2 Hz-100 MHz, AUTORANGING & dB		
HP	400EL	\$125.00
AC VOLTMETER		
HP	204C	\$125.00
AUDIO OSCILLATOR, 5 Hz-1.2 MHz		
HP	852A	\$275.00
TEST OSCILLATOR, 10 Hz-10 MHz, PRECISION AMPLITUDE		
HP	854A	\$175.00
TEST OSCILLATOR, 10 Hz-10 MHz		
HP	3336B	\$700.00
SYNTHESIZER/LEVEL GENERATOR, 10 kHz-21 MHz, 75 OHMS		
KROHN-HITE	3343	\$750.00
DUAL BANDPASS FILTER, 0.01 Hz-100 kHz, 48 dB/OCTAVE		
P.A.R.	189	\$450.00
FILTER/AMPLIFIER, 0.1 Hz-110 kHz, VARIABLE Q & GAIN		
TEK	AM501	\$100.00
OPERATIONAL AMPLIFIER		

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RF & MICROWAVE

HP	8552B	\$750.00
IF SECTION		
HP	8553B	\$500.00
RF SECTION: 1 MHz-110 MHz		
HP	8554B	\$800.00
RF SECTION: 0.1-1250 MHz		
HP	8555A	\$800.00
RF SECTION: 0.01-18 GHz		
TEK	7L13	\$2,200.00
SPECTRUM ANALYZER: 10 MHz-1800 MHz 30 Hz RES.		
TEK	TR501	\$800.00
TRACKING GENERATOR: 0.1-1800 MHz FOR 7L12/13		
TEK	TR502	\$950.00
TRACKING GENERATOR: 0.1-1800 MHz FOR 7L13/14		
TEK	TR503	\$1,750.00
TRACKING GENERATOR: 0.1-1800 MHz FOR 492/4/5/6		
HP	8405A	\$600.00
VECTOR VOLTMETER: 1-1000 MHz		
HP	8407A/8413A	\$300.00
NETWORK ANALYZER: 0.1-110 MHz WITH GAIN-PHASE DISPLAY		
HP	8410B/8413/8411A-018	\$750.00
NETWORK ANALYZER: 0.11-18.0 GHz W/GAIN-PHASE DISPLAY		
HP	8501A	\$350.00
STORAGE NORMALIZER FOR 8505A/8754A		
HP	8502B	\$425.00
REFLECTION-TRANSMISSION TEST SET: 0.5-1300 MHz 75 OHMS		
HP	8503A	\$950.00
S-PARAMETER TEST SET: 0.5-1300 MHz		
HP	8740A-H18	\$100.00
TRANSMISSION TEST UNIT: DC-18 GHz		
HP	8743B-018	\$375.00
REFLECTION-TRANSMISSION TEST SET: 2-18 GHz		
HP	8745A	\$675.00
S-PARAMETER TEST SET: 0.1-2.0 GHz		
HP	8746B	\$450.00
S-PARAMETER TEST SET: 0.5-12.4 GHz		
NARDA	7000A/7202/7208	\$1,950.00
SCALAR NETWORK AN/DIRECTIONAL BRIDGE: 0.1-18 GHz GPIB		
PACIFIC MEASUREMENTS	1038D10A113/2xV11	\$700.00
SCALAR NETWORK ANALYZER: 1 MHz-18 GHz W/3 DETECTORS		
WILTRON	580/580-87A50-1	\$1,650.00
NETWORK ANALYZER W/DIR. BRIDGE: 0.01-18 GHz 40 dB DIR.		
BOONTON/INTEGRA	VTS-100	\$1,750.00
VCO TEST SET: 2-18 GHz		
GIGATRONICS	1018-03.06.07	\$9,500.00
SYNTH. SIGNAL/SWEEP GEN. 0.05-18 GHz 1 kHz RES. OCXO		
GIGATRONICS	600/2-8	\$3,250.00
SYNTHESIZED SIGNAL GENERATOR: 2-8 GHz 1 kHz RES. GPIB		
HP	11710B	\$375.00
DOWN CONVERTER: 10 MHz-11 MHz OUTPUT FOR 8640/8654		
HP	11720A	\$1,200.00
PULSE MODULATOR: 2-18 GHz Tr<10ns. >80 dB		
HP	8614A	\$375.00
SIGNAL GENERATOR: 0.8-2.4 GHz		
HP	8614B	\$225.00
SIGNAL GENERATOR: 0.8-2.4 GHz		
HP	8640B-001.002	\$2,500.00
SIGNAL GENERATOR: 0.5-1024 MHz VAR. AUDIO OSC.		
HP	8683B	\$4,000.00
SIGNAL GENERATOR: 2.3-6.5 GHz		
HP	938A	\$300.00
FREQUENCY DOUBLER: 18.0-26.5 GHz 0 dBm OUTPUT		
HP	940A	\$300.00
FREQUENCY DOUBLER: 26.5-40.0 GHz 0 dBm OUTPUT		
WAVETEK	2410R	\$2,500.00
SYNTH. SIGNAL GENERATOR: 0.01-1100 MHz 10 Hz RES. AM/FM		
HP	8601A	\$500.00
SIGNAL/SWEEP GENERATOR: 0.1-110 MHz		
HP	8620C	\$550.00
SWEEP OSCILLATOR MAINFRAME		
HP	8621A	\$500.00
RF PLUG-IN: 0.1-4.2 GHz		
HP	86222B	\$1,700.00
RF PLUG-IN: 10-2400 MHz		
HP	86241A	\$400.00
RF PLUG-IN: 3.2-6.5 GHz		
HP	86245A-H80	\$300.00
RF PLUG-IN: 5.8-6.5 GHz		
HP	86290B	\$2,250.00
RF PLUG-IN: 2.0-18.6 GHz		
WAVETEK	1801A	\$500.00
SWEEP GENERATOR: 1-950 MHz 75 OHMS		
WAVETEK	2001A	\$650.00
SWEEP/SIGNAL GENERATOR: 1-1400 MHz		
WEINSCHEL	430	\$650.00
SWEEP GENERATOR: 2.0-12.4 GHz +10 dBm LEVELLED		
WILTRON	8647A	\$5,500.00
PROGRAMMABLE SWEEP GENERATOR: 0.01-18.6 GHz GPIB		
BOONTON	4200A-01A-03+48	\$800.00
DIGITAL POWER METER: GPIB W/11.1 MHz-12.4 GHz SENSOR		
BOONTON	42B/41-4E	\$650.00
ANALOG POWER METER: WITH 1 MHz-18 GHz SENSOR		
HP	432A/478A	\$300.00
POWER METER: 0.01-10 GHz -20 dBm TO +10 dBm F.S.		
HP	432B/478A	\$450.00
DIGITAL POWER METER: 0.01-10 GHz 10 uW-10 mW F.S.		
HP	435A/8481B	\$1,350.00
POWER METER: 0.01-18 GHz 0 TO +43 dBm F.S.		
HP	435A/8482A	\$1,000.00
POWER METER: 0.1-4200 MHz -20 dBm TO +20 dBm F.S.		
HP	8478B	\$250.00
THERMISTOR MOUNT: 0.01-18 GHz		
HP	K488A	\$300.00
WR42 THERMISTOR MOUNT: 18.0-26.5 GHz		
HP	R488A	\$300.00
WR28 THERMISTOR MOUNT: 26.5-40.0 GHz		
MARCONI	8960/8910	\$600.00
DIGITAL POWER METER: 0.01-20 GHz -20 TO +20 dBm GPIB		
BOONTON	9200A-01	\$950.00
RF MILLIVOLTMETER: 10 MHz-1.2 GHz GPIB		
HP	11975A	\$950.00
AMPLIFIER: 2-8 GHz +8 TO +18 dBm LEVELLED OUTPUT		
HP	8447A	\$300.00
AMPLIFIER: 0.1-400 MHz NF<7 dB, +8 dBm OUTPUT		
HP	8447E	\$700.00
AMPLIFIER: 0.1-1300 MHz NF<11 dB, +12.5 dBm OUTPUT		
AIITECH	230164-38	\$350.00
NOISE GENERATOR: 1.0-12.4 GHz 25 dB ENR		
AIITECH	230164-37	\$350.00
NOISE GENERATOR: 0.01-1.5 GHz 25 dB ENR		
AIITECH	230165-14	\$350.00
NOISE GENERATOR: 12.4-18.0 GHz 25 dB ENR		
AIITECH	7370	\$350.00
SYSTEM NOISE MONITOR: 80 MHz IF GPIB		
AIITECH	7615	\$350.00
NOISE GENERATOR: 0.01-1.3 GHz 15 dB ENR		
NOISECOM	5112	\$350.00
NOISE GENERATOR: 1.0-12.4 GHz 25.5 dB ENR		
SPECIFIC PRODUCTS	LFC-2	\$150.00
100 MHz LORAN-C FREQUENCY COMPARATOR		

COAXIAL & WAVEGUIDE

A.E.L.	ASN-112	\$750.00
CAVITY BACKED SPIRAL ANTENNA: 1-4 GHz N/m		
AVANTEK	SCA81-2295	\$500.00
AMPLIFIER MODULE: 1-4 GHz 20 dBG, +13 dBm OUTPUT		
BIRD	8890	\$800.00
2500 WATT OIL COOLED LOAD: DC-500 MHz		
DIELECTRIC COMM.	C43415	\$800.00
VARIABLE COAXIAL DELAY LINE: 0-250 DEG/GHz N/m		
FXR	X184A	\$2,200.00
WR90 ROTARY VANE ATTENUATOR: 0-50 dB 8.2-12.4 GHz		
HP	11691D	\$800.00
DIRECTIONAL COUPLER: 22 dB 2-18 GHz		
HP	11691D-005	\$950.00
DIRECTIONAL COUPLER: 22 dB 2-18 GHz ALL PORTS APC7		
HP	11692D-003	\$1,750.00
DUAL DIRECTIONAL COUPLER: 22 dB 2-18 GHz		
HP	33305B	\$600.00
PROGRAMMABLE STEP ATTENUATOR: 0-110 dB DC-18 GHz SMA		
HP	33311B	\$300.00
HIGH ISOLATION RF SPOT SWITCH: DC-18 GHz SMA/m/m		
HP	33320B-002	\$750.00
STEP ATTENUATOR: 0-11 dB DC-18 GHz SMA/m/m		
HP	382A	\$350.00
WAVEGUIDE PRECISION VAR. ATTENUATORS: S.J.H.X.P-BANDS		
HP	776D	\$250.00
DUAL DIRECTIONAL COUPLER: 20 dB 940-1900 MHz		
HP	778D-011	\$950.00
DUAL DIRECTIONAL COUPLER: 20 dB 0.1-2.0 GHz		
HP	779D	\$100.00
DIRECTIONAL COUPLER: 20 dB 1.7-12.4 GHz		
HP	805C	\$375.00
SLOTTED LINE: 0.5-4.0 GHz		
HP	809B/806A/444A	\$675.00
SLOTTED LINE: 2.0-12.4 GHz		
HP	8470A	\$450.00
CRYSTAL DETECTOR: 0.01-18.0 GHz APC7/BNC/m		
HP	8472A	\$125.00
CRYSTAL DETECTOR: 0.01-18.0 GHz SMA/m/BNC/m		
HP	8494B-001	\$125.00
STEP ATTENUATOR: 0-11 dB DC-18 GHz N/m		
HP	8495B-001	\$450.00
STEP ATTENUATOR: 0-70 dB DC-18 GHz N/m		
HP	908A	\$50.00
COAXIAL TERMINATION: 1/2 WATT DC-4 GHz N/m		
HP	K752A	\$500.00
WR42 DIRECTIONAL COUPLER: 3 dB 18.0-26.5 GHz		
HP	K752C	\$500.00
WR42 DIRECTIONAL COUPLER: 10 dB 18.0-26.5 GHz		
HP	R422A	\$300.00
WR28 CRYSTAL DETECTOR: 26.5-40.0 GHz		
HUGHES	45324H-1303	\$375.00
WR15 DIRECTIONAL COUPLER: 3 dB 50-75 GHz		
HUGHES	45324H-1330	\$375.00
WR15 DIRECTIONAL COUPLER: 30 dB 50-75 GHz		
HUGHES	45742H-1003	\$125.00
WR22 3 dB ATTENUATOR: 33-50 GHz		
KRYTAR	1822	\$175.00
SMA MINIATURE DIRECTIONAL COUPLER: 10 dB 2-18 GHz		
MICROTECH	M1537D11-00	\$150.00
DUAL DIRECTIONAL COUPLER: 20 dB 0.1-2.0 GHz N/m		
NARDA	1070-20	\$150.00
WR90 HIGH DIRECTIVITY COUPLER: 20 dB 8.2-12.4 GHz		
NARDA	2313A	\$125.00
BROADBAND POWER DIVIDER: 2.0-12.4 GHz N/m		
NARDA	3000-SERIES	\$150.00
DIRECTIONAL COUPLERS		
NARDA	4000-SERIES	\$75.00
SMA MINIATURE DIRECTIONAL COUPLERS		
NARDA	792FM	\$200.00
VARIABLE ATTENUATOR: 0-20 dB 2.0-12.4 GHz N/m		
OMNI-SPECTRA	20040L	\$125.00
SLIDING LOAD: 4.0-26.5 GHz APC3.5		
OMNI-SPECTRA	2024-6428-20	\$75.00
SMA MINIATURE DIRECTIONAL COUPLER: 20 dB 8.0-12.4 GHz		
OMNI-SPECTRA	2086-8000-13	\$40.00
CRYSTAL DETECTOR: 1-15 GHz SMA/m/m		
PRD	621AF1	\$200.00
WR42 TUNABLE CRYSTAL DETECTOR: 18.0-26.5 GHz		
PRE	K4-10F1	\$350.00
WR42 DIRECTIONAL COUPLER: 10 dB 18.0-26.5 GHz		
RLC	12598-M	\$150.00
BIDIRECTIONAL COUPLER: 20 dB 50-1000 MHz		
TRG	551W/387	\$550.00
WR10 FREQUENCY METER: 75-110 GHz		
TRG	V561-20	\$300.00
WR15 DIRECTIONAL COUPLER: 20 dB 50-75 GHz		
WAVELINE	1019	\$250.00
WR28 ROTARY VANE ATTENUATOR: 0-80 dB 26.5-40.0 GHz		
WEINSCHEL	2173	\$75.00
VARIABLE ATTENUATOR: 0-10 dB 2.5-11.0 GHz N/m		
WEINSCHEL	905	\$75.00
VARIABLE ATTENUATOR: 0-10 dB DC-1 GHz N/m		
WEINSCHEL	933	\$150.00
VARIABLE ATTENUATOR: 3-120 dB DC-500 MHz N/m		
WEINSCHEL	940-80-44	\$200.00
VARIABLE ATTENUATOR: 0-80 dB DC-4 GHz N/m		
WEINSCHEL	973LS-10	\$75.00
VARIABLE ATTENUATOR: 0-10 dB 1.3-11.0 GHz N/m		

LOGIC

TEK	1240/D2/D2	\$1,250.00
LOGIC ANALYZER: 36 CHANNELS 50 MHz MONO DISPLAY		
TEK	1241/D2/D2	\$1,450.00
LOGIC ANALYZER: 36 CHANNELS 50 MHz COLOR DISPLAY		
TEK	30DM08	\$100.00
80286 SOFTWARE & DISASSEMBLY PROBE FOR TEK 3001		
TEK	DP186P	\$50.00
80186/188 DISASSEMBLY PROBE FOR TEK 1230		
TEK	DP286P	\$50.00
80286/80287 DISASSEMBLY PROBE FOR TEK 1230		
TEK	DPHC11	\$125.00
68HC11 DISASSEMBLY PROBE FOR TEK 1230		
TEK	P8454	\$50.00
100 MHz CLOCK PROBE FOR DAS		
TEK	8540A/8300P56	\$250.00
MIL-STD-1750A BUS INTEGRATION UNIT		

COMMUNICATIONS

DATUM	9100	\$250.00
IRIG TIME CODE GENERATOR		
DATUM	9390-710	\$450.00
SYNCHRONIZED IRIG(A/B) TIME CODE GENERATOR		
HEKIMIAN	3900	\$350.00
COMMUNICATION TEST SET: VARIOUS PLUG-INS AVAILABLE		
HP	28627A	\$750.00
LAN WIRE TEST INSTRUMENT		
HP	3555B	\$200.00
TRANSMISSION & NOISE MEASUREMENT SET		
HP	3711A/3791B	\$1,250.00
IF/BB TRANSMITTER		
HP	3712A-004/3793B	\$1,400.00
IF/BB RECEIVER WITH DIFFERENTIAL PHASE DETECTOR		
HP	3776B	\$1,000.00
PCM TEST SET		
HP	4951C-103	\$1,250.00
RS-232C/24 PROTOCOL ANALYZER		
HP	59401A	\$875.00
HPIB BUS ANALYZER		
HP	853A-H01	\$175.00
TEST OSC: 10 Hz-10 MHz VIDEO MODULATION WECO OUTPUT		
HP	83001A	\$750.00
MICROWAVE REPEATER: 3.7-4.2 GHz CCR 25 CHANNELS 1 WATT		
MARCONI	TF-2807M	\$250.00
PCM MULTIPLEX TEST SET		
SCI ATLANTA	4651B/4657B-005	\$700.00
DS3 BERTS PAIR GPIB		
TEK	144	\$700.00
NTSC TEST SIGNAL GENERATOR		
TEK	1480R	\$850.00
NTSC WAVEFORM MONITOR		
UNITED DETECTOR	161/248/2525	\$300.00
IR-VISIBLE LIGHT PHOTOMETER WITH INTEGRATING SPHERE		
WANDEL & GOLTERMANN	PMD-1	\$500.00
TRANSMISSION MEASUREMENT SET: 20 Hz-200 kHz		

MISCELLANEOUS

FLUKE	2175A	\$150.00
TYPE T THERMOMETER		
FLUKE	2190A/2300A/1120A	\$875.00
10-CHAN. SCANNING THERMOMETER TYPES J,K,T,R,C GPIB		
HP	37203A	\$75.00
HPIB EXTENDER		
HP	5004A	\$150.00
SIGNATURE ANALYZER		
HP	59303A	\$150.00
HPIB ANALOG TO DIGITAL CONVERTER		
HP	59306A	\$200.00
HPIB RELAY ACTUATOR		
HP	59307A	\$200.00
HPIB VHF SWITCH		
HP	59308A	\$150.00
HPIB TIMING GENERATOR		
HP	7035B	\$200.00
X-Y ANALOG PLOTTER		
HP	7475A-002	\$400.00
6-PEN GRAPHICS PLOTTER HP/IB		
HP	82937A	\$75.00
HPIB INTERFACE FOR 80-SERIES COMPUTERS		
HP	82939A	\$75.00
SERIAL INTERFACE FOR 80-SERIES COMPUTERS		
KEITHLEY	7052/27158	\$500.00
LOW CURRENT SCANNING SYSTEM GPIB		
P.A.R.	128A	\$500.00
LOCK-IN AMPLIFIER: 0.5 Hz-100 kHz		
P.A.R.	4420/4421	\$750.00
BOXCAR AVERAGER. REQUIRES TEK S-SERIES SAMPLING HEAD		
TEK	040-0852-05	\$50.00
TM 500-SERIES SINGLE SLOT BLANK PLUG-IN		
TEK	040-0803-02	\$60.00
TM500-SERIES SINGLE SLOT BLANK PLUG-IN W/POWER SUPPLY		
TEK	TM5003	\$425.00
5000-SERIES 3-SLOT PROGRAMMABLE POWER MODULE		
TEK	TM5006	\$600.00
5000-SERIES 6-SLOT PROGRAMMABLE POWER MODULE		
TEK	TM501	\$175.00
500-SERIES SINGLE SLOT POWER MODULE		
TEK	TM503	\$150.00
500-SERIES 3-SLOT POWER MODULE		
TEK	TM504	\$150.00
500-SERIES 4-SLOT POWER MODULE		
TEK	TM508	\$250.00
500-SERIES 6-SLOT POWER MODULE		
TEK	TM506/OPT. 10	\$200.00
500-SERIES 8-SLOT RACKMOUNT POWER MODULE		
TEK	TM515	\$250.00
500-SERIES 5-SLOT TRAVELLER POWER MODULE		
TEK	TS18150	\$900.00
TEST SYSTEM INTERFACE W/41 TSS40 SCANNER CONTROLLERS		
TEK	TSS41	\$17.00
LOW LEVEL SCANNER		
TEK	TSS45	\$175.00
RF SCANNER		

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TURES: C. DEALER INFO: Setup 8am. **CONTACT:** Mark Zolla, 508-744-8440.

NJ - AUGUSTA — SCARC '93. **SPONSOR:** Sussex County ARC. **LOCATION:** Sussex County Fairgrounds, Plains Rd., off Rte. 206. **HOURS:** 8am-7. **ADMISSION:** \$5. **XYLS & Harmonics free.** **FEATURES:** FP - F/R - T. **DEALER INFO:** Indoor tables \$10/8'. Tailgate space \$8. **CONTACT:** Don Strickle K2OX, 185 Weldon Rd., Lake Hopatcong NJ 07849. 201-663-0677.

NJ - CHERRY HILL — Cherry Hill Computer Fair & Sale. **LOCATION:** Garden State Park Racetrack, Rt. 70 (opposite Holiday Inn). **HOURS:** 10am-4pm. **ADMISSION:** \$6. **FEATURES:** C. **DEALER INFO:** 400+ tables, 6000+ expected attendance, 7:30am set-

up. **CONTACT:** Tri-State Fairs.*

NY - BREWSTER — Pearlfest Hamfest & Flea Market. **SPONSOR:** Putnam Emergency & Amateur Rpt. League. **LOCATION:** Brewster High School on Foggintown Rd. **HOURS:** 8am-2pm. **TALK-IN:** 145.130 -600. **FEATURES:** EX. **CONTACT:** Shirley Dahlgren N2SKP, 914-736-0717.

PA - PITTSBURGH — 8th Annual Hamfest. **SPONSOR:** North Hills Amateur Radio Club. **LOCATION:** Northland Public Library, 300 Cumberland Rd. **HOURS:** 8am-3pm. **ADMISSION:** Free. **TALK-IN:** 147.09. **FEATURES:** DP - FP - F/R - T. **DEALER INFO:** Indoor tables \$10 ea. (limited). 1 free tailgate space, ea. additional space \$5. **CONTACT:** Don Jackson N3LAZ, 8 Dale Ave., Bradford Woods PA

15015. 412-935-3343.

JULY 17

FL - WEST PALM BEACH — Narisaam Computer Show. **SPONSOR:** NARISAAM, Inc. **LOCATION:** Palm Beach Airport Hilton, 150 Australian Ave. **HOURS:** 10am-4pm. **ADMISSION:** \$5, \$4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** NARISAAM.*

ME - UNION — Union Hamfest & Computer Fair. **SPONSOR:** Maine Hamfest Assoc., Inc. **LOCATION:** Union Fairgrounds, Rte. 17. **HOURS:** 8am-1pm. **ADMISSION:** \$2. **CONTACT:** Rod Scribner, 207-582-6125.

NC - CARY — 21st Annual Cary Mid-Summer

Swapfest. **SPONSOR:** Cary Amateur Radio Club. **LOCATION:** Cary Community Center. **HOURS:** 8am-7. **ADMISSION:** \$4 adv., \$5 door. **TALK-IN:** 147.75/15. **FEATURES:** AC - CB - DP - EX - F - FM - T. **CONTACT:** Herb Lacey, 1022 Medlin Dr., Cary NC 27511, or 919-467-9608.

NH - NASHUA — Winter Swap & Sell Meet. **SPONSOR:** New England Antique Radio Club. **LOCATION:** Resurrection Center, 449 Broad St. **HOURS:** 8am-1pm. **ADMISSION:** Early buyer (8-9am) \$5; general (9am-1pm) \$1. **FEATURES:** Antique and collectible radios, TVs, parts, books, etc. **DEALER INFO:** 100 tables. **CONTACT:** Ray Lumb, NEARC, 228 N. Main St., Millbury MA 01527.

NY - SKANEATELES — Skanfest. **SPONSOR:** Skaneateles Lions Club. **LOCATION:** Allyn Arena, Austin St. **HOURS:** 7:30am-3pm. **ADMISSION:** \$3 adv., \$4 door, under 12 free. **TALK-IN:** 147.00-, 442.3+ **FEATURES:** DP - EX - FM - F/R. **DEALER INFO:** 8' paved outdoor area \$3 adv., \$4 gate. Indoor 8' table \$8 adv., \$9 gate. Indoor 8' table w/electric plug \$9 adv., \$10 gate. **CONTACT:** Skanfest '93, Skaneateles Lions Club, POB 302, Skaneateles NY 13152.

JULY 17-18

PA - NORTH WALES — PC Dealer Showcase. **SPONSOR:** Star Ware. **LOCATION:** Montgomery Mall. **HOURS:** Sat. 10am-9:30pm, Sun. Noon-5pm. **ADMISSION:** Free. **FEATURES:** AC - FP - F/R. **CONTACT:** Star Ware 800-523-0702.

JULY 18

FL - FORT LAUDERDALE — Narisaam Computer Show. **SPONSOR:** NARISAAM, Inc. **LOCATION:** Holiday Inn West, 5100 N State Rd 7. **HOURS:** 10am-4pm. **ADMISSION:** \$5, \$4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** NARISAAM.*

MA - CAMBRIDGE — Tailgate Electronics, Computer and Amateur Radio Flea Market. **SPONSOR:** MIT Electronics Research Society, the MIT Radio Society and the Harvard Wireless Club. **LOCATION:** Albany and Main St. **HOURS:** 9am-2pm, rain or shine. **ADMISSION:** \$2. **TALK-IN:** 146.52, 449.725/444.725 - PL 2A. **FEATURES:** C - E - H. **DEALER INFO:** Room for 400 sellers. \$5 adv (before the 5th), \$8 gate (includes 1 admission). 7am setup. **CONTACT:** WIGSL, PO Box 82 MIT BR., Cambridge MA 02139; 617-253-3776.

NH - NASHUA — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Sheraton Tara. **HOURS:** 10am-3:30pm. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Mark Zolla, 508-744-8440.

NJ - SECAUCUS — Meadowlands Computer Fair & Sale. **LOCATION:** The Hilton, off Rte. 3 Meadowlands Pkwy. **HOURS:** 9:30am-4:30pm. **ADMISSION:** \$6, \$5 after 1pm. **FEATURES:** C. **DEALER INFO:** Setup 7am. 250 tables. **CONTACT:** Tri-State Fairs.*

JULY 24

NY - GOWANDA — 4th Annual Swap 'N Shop. **SPONSOR:** Tri-County Amateur Radio Society. **LOCATION:** Gowanda Fireman's Grounds, Sand Hill (Rte. 62). **HOURS:** 7am-7. **ADMISSION:** \$5 includes (1) 8' flea market space. **TALK-IN:** 146.745. **FEATURES:** FM - F/R. **CONTACT:** Andy K2ISN, 716-532-2250 or Tom KD2EG, 716-532-5743.

PA - HUNTINGTON MILLS — Hamfest. **SPONSOR:** Jonestown Mountain Repeater Assoc. **LOCATION:** Huntington Valley Volunteer Fire Co., Rte. 239. **HOURS:** 8am-3pm. **ADMISSION:** \$2, spouses & children free. **TALK-IN:** 146.79, 145.41 & 146.52. **FEATURES:** DP - EX - FM - FP - F/R - T. **CONTACT:** AD3L, 717-864-2571.

PA - LANCASTER — 11th Annual Red Rose Repeater Computer Electronic Show. **SPONSOR:** Red Rose Repeater Assn, Inc. **LOCATION:** McCaskey High School on Reservoir St. **HOURS:** 9am-3pm. **ADMISSION:** \$4, under 14 free with paying adult. **TALK-IN:** 147.015. **FEATURES:** AC - C - DP - F/R - T. **CONTACT:** Wade Mackey, 5 Sunrise Terrace, Millersville PA 17551, 717-872-5328.

VA - TYSONS CORNER — CMA Computer Show. **LOCATION:** Westpark Hotel, Leesburg Pike (DC Capital Beltway). **HOURS:** 9:30am-3pm. **ADMISSION:** \$5, under 12 free. **FEATURES:** C. **DEALER INFO:** 6-ft table \$60 incl electricity, 7:30am setup. **CONTACT:** CMA Shows, 804-272-1570.

JULY 24-25

NC - ASHEVILLE — 18th Annual Western Carolina Hamfest. **SPONSOR:** Western Carolina Amateur Radio Society. **LOCATION:** Haywood County Fair Grounds. **ADMISSION:** \$4 adv., \$5 gate. **TALK-IN:** 146.76. **FEATURES:** DP - EX - FM - T. **DEALER INFO:** Carl N4AA, 704-683-4251. **CONTACT:** Jean WB4KRZ, 704-252-9806 or WCARS Hamfest, POB 1488, Asheville NC 28802-1488.

NH - MANCHESTER — ARRL New England Division Convention. **SPONSOR:** New Hampshire ARA. **LOCATION:** New Hampshire Holiday Inn, 700 Elm St.

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Now your TV can sound as great as your stereo system. The Teleonic Model #2001, when properly installed in your television set, will produce two separate high-fidelity channels which can be run through your home stereo. By using the controls on your stereo, you can vary volume and tone of your TV. Music videos, movie sound tracks and sports programs will come alive with fantastic new sound. THIS UNIT REQUIRES SOME TECHNICAL SKILL TO INSTALL: In order to install it you need to remove the back of your TV and make solder connections to your speaker wire, to your 115Vac input and to a pair of RCA jacks which are included in the kit and need to be installed in the back cover of the set. Instructions and cables included. **CAT# TV-2001** \$4.00 each

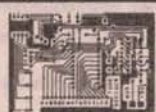


TWO CHANNEL COLOR ORGAN



Create your own light shows. Electret mike on control board responds to music or other sounds causing lights to brighten and dim depending on frequency and volume. 120 Vac input and output. Provisions for two light strings, up to 200 watts per channel. Separate sensitivity controls for each channel. 0.25" qc terminals for output. Lights not included. 4.25" X 3.85". Hook-up diagram included. **CAT# CORG-1** \$6.50 each

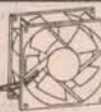
Make PC Boards in Minutes...



Prototypers, developers and hobbyists can now make PC boards direct from CAD, PCB layout systems or magazines using a photocopier, or laser printer. Techniks Inc's new "Press-n-Peel" copy paper allows you to photocopy PC artwork and iron it onto copper-clad board. It can then be chemically etched in the usual fashion. The process is so easy and fast you won't believe it. Five 8 1/2" X 11" sheets and instructions. **CAT# TEK-5** \$9.95 each

12 Vdc FAN

Elina Fan #MDA 120925LB 12 Vdc, 110 ma. Black thermoplastic housing and 5 blade impeller. 3.63" square X 1" thick. 14" pigtail leads. **CAT# CF-128** \$7.50 each



VIDEO/RF MODULATOR

Originally made for use with the Commodore computer, these good quality video modulators were probably originally designed for 9 Vdc use, but they operate well on 6-12 Vdc. They accept color video and audio, and a selector switch is provided for output to channel 2 or 3. Easy to hook-up. Requires a 6-12 Vdc power supply or wall transformer and a connector to interface with your audio/video source. Output is an RCA jack. Hook-up instructions included. 3" X 1.47" X 0.75". **CAT# AVMOD-3** \$5.00 each



JUMBO LED'S

Big, bright 10 mm dia. LED's will attract attention in any display or panel. Twice the dia. of regular LED's, stand about 10 mm above panel. **RED MAXI LED CAT# LED-22R** 3 for \$1.00 **GREEN MAXI LED CAT# LED-22G** 3 for \$1.00



SOLID STATE DIP RELAY

International Rectifier #DP61K "Chipswitch" SPST normally open solid state relay in DIP configuration. AC Load: 300 ma., 20-280 Vac DC Input (turn on): 5 to 25 ma. The DC input can be any voltage as long as the current is maintained between 5 and 25ma. Use a dropping resistor to do this. LARGE QUANTITIES !!! **CAT# SSRLY-03** \$1.50 each. 25 for \$31.25

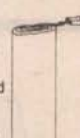


D.C. Wall Transformers (120 Vac INPUT)

Volts	Amps	Plug Style	Center	Cat#	Price
8.3 Vdc	10 ma.	battery snap		DCTX-8310	\$1.50
12 Vdc	100 ma.	2.1 mm co-ax	negative	DCTX-1210	\$2.50
12 Vdc	500 ma.	2.1 mm co-ax	negative	DCTX-125	\$4.50
12 Vdc	800 ma.	2.5 mm co-ax	positive	DCTX-1281	\$5.25
14 Vdc	700 ma.	1.3 mm co-ax	negative	DCTX-1470	\$5.25
15 Vdc	400 ma.	2.5 mm co-ax	negative	DCTX-1540	\$4.50
17 Vdc	300 ma.	none		DCTX-1730	\$1.50

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4 (USED) AA RECHARGEABLE BATTERIES

Battery pack with 4 AA nickel-cad batteries in series to make a 4.8 volt pack. Batteries have soldertabs and can be separated and reconfigured. **CAT# NCB-4TAAU SPECIAL!** \$2.00 per pack



(USED) AA RECHARGEABLE BATTERIES

Standard 1.20 Vdc 500 mAh nickel cadmium rechargeable batteries. Guaranteed. **CAT# NCB-AAU** \$1.00 each



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Replace broken or intermittent test leads. Red and black lead set with banana plug on one end and pin probe on other end. 3 feet long. **CAT# TL-100** \$2.00 per set



12 Vdc LATCHING RELAY

Midtex #327-21B200 12 Vdc, 400 ohm dual coil latching relay. DPDT, 2 amp contacts. Fits 16 pin DIP socket. 0.8" X 0.4" X 0.33". UL listed. **CAT# LRLY-125** \$2.00 each



DC-DC CONVERTER

Satellite Technology Services, Inc. #AV 011 Input: 13.75 Vdc to 27.5 Vdc Output: 13.75 Vdc @ 1.3 amps Plugs into cigar lighter receptacle in car or airplane. Converts, filters and regulates voltage for use with 12 Vdc appliances. Fused cigar lighter plug on heavy duty 3 ft cable. 1/2 ft cord on output side terminates with a small DC co-ax power plug that, in most cases, would need to be cut-off and replaced with another type of plug. Ideal for powering portable TVs, communications equipment etc. **CAT# AV-011** \$5.00 each



STEPPER MOTOR

Shinano Kenshi Co. #STH-56D101 4 wire stepper motor. 1.8 degrees per step. 12 ohm coil. 2.22" dia. X 1.55" high. 0.25" diameter shaft with removable aluminum end assembly. 2.22" square mounting bracket. **CAT# SMT-12** \$2.50 each



4 Digit Alphanumeric Intelligent Display

Siemens #DL-2416T. End-stackable, four digit display module with built-in CMOS memory decoder/driver. High contrast, 160" high magnified red characters. Direct access to each digit independently and asynchronously. ASCII format. 5 volt logic, TTL compatible. Module size: 1" X 0.8" X 0.25". Includes specs and instructions. Sells elsewhere for as much as \$19.95. **CAT# DL-2416T** \$4.95 each



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ITT Magicflash. Originally designed for Polaroid One-Step and Pronto cameras. Nice bright flash can be triggered by external 3 Vdc pulse. Operates on 6 Vdc, 4 AA cells (not included). Useful for special effects of flash lighting. Circuitry includes a very desirable 600 uF 330V photoflash capacitor which is, by itself, worth the price of the unit. **CAT# FSH-2** \$3.00 each



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Ideal for remote control systems, burglar alarms, flow rate detectors etc. Transmitter #EFR-OHB40K24 0.5" dia. X 0.37" Receiver: #EFR-RUB40K25 0.63" dia. X 0.48" Center frequency: 40 KHz. Band width: 4KHz + **CAT# UST-23** \$2.00 per set



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TR-400B	4"	18 lbs	black	15/16"	.35	\$3.00	\$17.50
TR-600	6"	30 lbs	neutral	1 1/2"	.50	\$4.00	\$30.00
TR-600B	6"	30 lbs	black	1 1/2"	.50	\$4.00	\$30.00
TR-800	8"	50 lbs	neutral	1 3/4"	.60	\$5.00	\$40.00
TR-800B	8"	50 lbs	black	1 3/4"	.70	\$6.00	\$50.00
TR-1100	11"	50 lbs	neutral	3"	.70	\$6.00	\$50.00
TR-1100B	11"	50 lbs	black	3"	.80	\$7.00	\$60.00
TR-1500	15"	50 lbs	neutral	4"	\$1.00	\$8.00	\$70.00
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Events CALENDAR

HOURS: Sat. 8am-5pm, Sun. 9am-2pm. **ADMISSION:** \$4 adv., \$5 door. **TALK-IN:** 146.850-147.255+. **FEATURES:** CB - DP - EX - F - FM - F/R. **CONTACT:** New Hampshire Amateur Radio Assoc., POB 573, Derry NH 03038.

JULY 25

MA - TAUNTON — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Taunton Holiday Inn. **HOURS:** 10am-3:30pm. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Mark Zolla, 508-744-8440.

MD - BALTIMORE — Maryland Hamfest & Computer Fest. **SPONSOR:** The Baltimore Radio Amateur Television Society. **LOCATION:** Timonium Fairgrounds, York Rd. **ADMISSION:** Kds under 12 free. **TALK-IN:** 147.03+, 224.96-. **FEATURES:** C - DP - EX - FM - F/R - T. **CONTACT:** BRATS, POB 5915, Baltimore MD 21208. 410-583-9147.

PA - MONROEVILLE — Pittsburgh Computer Fair & Sale. **LOCATION:** Palace Inn, off PA Tpke Exit 6 near Int of Rts 22 and 48. **HOURS:** 9:30am-4pm. **ADMISSION:** \$5. **FEATURES:** C. **DEALER INFO:** 150 tables, 7:30am setup. **CONTACT:** Tri-State Fairs.*

JULY 31

NY - ALBANY — Albany Computer Fair & Sale. **LOCATION:** Polish Community Center, 225 Washington Ave. Ext. **HOURS:** 9am-3pm. **ADMISSION:** \$5. **DEALER INFO:** 120 tables. Setup 7am. **CONTACT:** Tri-State Fairs.*

NY - MELVILLE — Long Island Computer Show. **LOCATION:** Huntington Hilton (formerly Royce Carlson), LI Expressway Exit #49-South, 1/2 mi on right. **HOURS:** 10am-3pm. **FEATURES:** C. **DEALER INFO:** 200 tables (\$10 S/C). **CONTACT:** KGP Computer Shows.*

JULY 31 - AUGUST 1

FL - JACKSONVILLE — Greater Jacksonville Amateur Radio & Computer Show/ARRL Florida State Convention. **LOCATION:** Osborn Convention Center, I-95 at Bay St. exit. **HOURS:** Sat. 9am-5pm, Sun. 9am-3pm. **ADMISSION:** \$6. **FEATURES:** AC - EX - FP. **DEALER INFO:** Tables \$18 both days, Setup Fri. 2pm-7pm, Sat. 7am-9am. To order tables, send payment to: David Phillips, POB 9726, Jacksonville FL 32208. **CONTACT:** POB 10623, Jacksonville FL 32207.

NJ - LAWRENCEVILLE — PC Dealer Showcase. **SPONSOR:** Star Ware. **LOCATION:** Quakerbridge Mall. **HOURS:** Sat. 10am-9:30pm, Sun. Noon-5pm. **ADMISSION:** Free. **FEATURES:** AC - FP - F/R. **CONTACT:** Star Ware 800-523-0702.

AUGUST 1

NC - CHARLOTTE — Queen City Hamfest & Computer Fair. **SPONSOR:** Charlotte ARC. **LOCATION:** Roll-A-Round Skating Rink, 8830 E Harris Blvd. **HOURS:** 8am-4pm. **ADMISSION:** \$4. **TALK-IN:** 147.060-146.46/444.85-449.85. **FEATURES:** FP. **CONTACT:** Francis Nakamura WB4ETF, Charlotte ARC, POB 33582, Charlotte NC 28233. 704-335-0752.

NJ - HANOVER — Hanover NJ Computer Fair & Sale. **LOCATION:** Marriott Hotel, Rt 10 East, near Rts 287, 280, 80. **HOURS:** 9:30am-3pm. **ADMISSION:** \$6. **FEATURES:** C. **DEALER INFO:** 160 tables, 2500 expected attendance. 7:30am setup. **CONTACT:** Tri-State Fairs.*

VA - BERRYVILLE — Winchester Hamfest Computer Show. **SPONSOR:** Shenandoah Valley Amateur Radio Club. **LOCATION:** Clarke County Ruritan Fairgrounds. **HOURS:** 6am-7. **ADMISSION:** \$5, tailgaters \$7. **TALK-IN:** 146.22-82 & 52. **FEATURES:** DP - F/R - T. **CONTACT:** Irv Barb 955-1745 or SVARC, POB 139, Winchester VA 22601.

AUGUST 7

CT - NEW HAVEN — PC Fest Computer Show & Sale. **LOCATION:** New Haven Coliseum. **HOURS:** 10am-4pm. **ADMISSION:** \$7, under 10 free. **FEATURES:** C. **CONTACT:** PC Fest Computer Shows.*

MA - MARLBOROUGH — Boston Area Computer Show. **LOCATION:** Royal Plaza Trade Center, I-495 Exit #24-B, 4 mi. N of Mass. Turnpike on Rt. 20. **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 500 tables. **CONTACT:** KGP Computer Show.*

PA - BETHLEHEM — Musicians Flea Market. **SPONSOR:** Se Wy-Co Fire Company & Emergency Medical Services. **LOCATION:** SE Wy-Co Fire Co., Rte. 378. **HOURS:** 10am-4pm. **ADMISSION:** Free. **DEALER INFO:** Inquiries: 215-865-9151 (9am-9pm). **CONTACT:** Bill or Linda Koehler, 215-865-9151.

SC - COLUMBIA — Columbia Hamfest & Computerfest. **SPONSOR:** Palmetto Personal Computer Club. **LOCATION:** Heathwood Hall School, 3000 S Beltline Blvd. **HOURS:** 10am-3pm. **ADMISSION:** Free. **CONTACT:** Buster White, 803-698-9115.

AUGUST 7-8

GA - MARIETTA — Atlanta Area Computer Show. **LOCATION:** Cobb County Civic Center, 548 S.

Marletta Pkwy. I-75 exit 112, Hwy 120 W. **HOURS:** Sat. 9am-5pm, Sun. 10am-4pm. **ADMISSION:** \$5 both days, \$4 Sun only. **FEATURES:** AC - C - DP - FP - F/R - RV-S. **DEALER INFO:** 8-ft tables \$35 for both days. Setup Sat. 6-9am, security. **CONTACT:** POB 295, Riverdale GA 30274. 404-907-6225.

AUGUST 8

KY - FRANKFORT — Central Kentucky ARRL Hamfest. **SPONSOR:** Bluegrass Amateur Radio Society, Inc. **LOCATION:** Western Hills High School, Exit 53 off I-64. **ADMISSION:** \$5 adv, \$6 door. **FEATURES:** AC - CB - EX - F - FM. **DEALER INFO:** Tables \$15, \$25 after July 15. **CONTACT:** Bill De Vore, 606-257-3343 or 606-273-8345.

NY - ALBANY — PC Fest Computer Show & Sale. **LO-**

CATION: Knickerbocker Arena. **HOURS:** 10am-4pm. **ADMISSION:** \$7, under 10 free. **FEATURES:** C. **CONTACT:** PC Fest Computer Shows.*

NY - WHITE PLAINS — WECAFEST '93. **SPONSOR:** Westchester Emergency Communications Assn. **LOCATION:** Westchester County Center. **FEATURES:** AC - CB - F - FM - FP. **CONTACT:** WECAFEST '93, Jeanne Raffaelli N2NQY, 544 Manhattan Ave., Thornwood NY 10594. 914-962-9666.

PA - WARRINGTON — Mid-Atlantic ARC Hamfest. **SPONSOR:** Mid-Atlantic ARC. **LOCATION:** Bucks County Drive-In Theatre, on US 611. **HOURS:** 8am-7. **ADMISSION:** \$4 per ham, \$3 each tailgate space. **TALK-IN:** 147.66/147.06 & 146.52. **DEALER INFO:** Setup 7am. **CONTACT:** Al Maslin W3DZL, 215-446-4936.

AUGUST 13-14-15

CT - VERNON — Eastern VHF/UHF/SHF Conference. **LOCATION:** Quality Inn on Hartford Turnpike (State Rts. 30 & 83). **FEATURES:** B - FM. **CONTACT:** Lewis D. Collins, 508-358-2854.

AUGUST 14

MA - FALL RIVER — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** White's of Westport. **HOURS:** 10am-3:30pm. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Mark Zolla, 508-744-8440.

MA - SPRINGFIELD — PC Fest Computer Show &

Continued on page 92

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Data I/O 120A, Gang Programmer 249
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Beckman CT-233 AC/DC Hall clamp-on current probe. 1 mV/A output 0-200A/0-600A 89

INSTRUMENTATION

HP3968P Instr. tape recorder, 8Ch. 1/4" 1299
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TEK4662, XY 11x17, 8 PEN, RS232C, IEEE 299
Plotter 4 pen RS232A, A B size, Acad dvr 99
Gimini 3300 uP Batch counter 2 input, 6dgt process ind. Completely programmable \$ 99
Ectron 750EL Diff. DC Amp. Gain 1-1K, filter 1-20Khz. Qty 12 in 5 1/4"x17" RackMnt 399
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OCTAPAC OP80 or OP90 New 199
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AT Case	3-5 1/4", 1-3.5", 200 W	80

KEYBOARDS

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Fujitsu 4700 101 Key	53

VIDEO

Mono graphics with printer port	\$ 13
VGA 8 bit	33
SVGA 1024 x 768, 1 Meg	69
SVGA 1280 x 1024, 1 Meg	75

MONITORS

SVGA Shamrock Color 14" screen .28 mm	
1024x768, 800x600, 640x480	\$ 329
SVGA INTRA Color 14" screen .28 mm	
1024x768, 800x600, 640x480	294
SVGA INTRA Same, but non-interlaced	330
Casper 12" Monochrome amber or white	87
TAXAN 1901 Crystal View 19", white mono	350

MODEMS

2400/1200/300B Int./Ext. with MNP5	35/58
9600/2400B Int./Ext. FAX Modem	65/107
9600B Modem Int./Ext. with MNP5	222/234

HARD & FLOPPY CONTROLLERS

AT HD/FD Controller, MFM 1:1 with cables	\$ 62
IDE 1HD, 2.88Mb FDD	54
IDE HD/FL/2 Ser/Par/Game/With cables	21
IDE HD/FD Controller 2 HD, 2 FDD	14
Super FI. contr. 1.44, 1.2, 720, 360, AT/XT	27
360K/1.2 Mb/1.44 Mb/2.88 FDD	59/54/48/90
MAXTOR 7245AT 245 Meg IDE Harddrive	290

MISCELLANEOUS

80C287A-12 Intel Math co-roc. For Laptops	91
AT I/O 2Serial (Com 1,2,3,4) 1 Parr, 1 Game	16
Serial Mouse, Windows and Dos6 compatible	15
Trackball mouse, with PS, software & manual	35
80286-8 CPU board, uses passive backplane and external mem. board	35
AT Passive Backplane 8 slot, Kb & PS conn.	35
Z80 Controller with 8 bit A/D & Schematic	15
HV PS 15-30VDC in, 100V, 400V, 16KV out	6
Rubber Testlead wire, red or blk	4ft/\$ 1.00

WYSE 286-12 AT BOARD

2012 series. 12MHz CPU motherboard and daughterboard assembly. This unit plugs directly into a backplane and includes 1 Meg. of DRAM. Norton SI= 12. All boards are tested and include documentation and a 5.25" WYSE setup diskette. Phoenix bios.
286 with 1 Meg DRAM \$55 With backpin \$74

PART 2

by Anthony Charlton

Welcome. This time we have a good deal of ground to cover, so let's plunge right in! Our first project involves making a homemade galvanometer. With this, we can use a laser to demonstrate an optical lever and measure small currents. Of course, we can use a DMM for this, but re-creating scientific experiments of yesteryear with modern tools is sort of fun, eh?

One can more easily grasp the principles of commercial "Galvos" as they are nicknamed, after experimenting with this set-up. Our Galvo will consist of a lightweight mirror on which a small magnet is cemented, a coil of wire, and a support (see Figure 1). Compact and strong magnets can be salvaged from a small speaker or toy DC motor. Or you can buy one from Edmund Scientific; they have a wide selection. The prototype's wire coil consists of 100 turns of #30 magnet wire which was first wrapped around a form (you can use any non-metallic form such as a cut-off paper towel core) and glued in place with epoxy at several spots. I realize not everyone has access to magnet wire so you can try bell wire, lightweight speaker wire, wire-wrap or hook-up wire, etc. The more turns you have on the core, the stronger the magnetic field will be, and hence more sensitive your Galvo will be. If needed, you can get away with fewer turns at a sacrifice in sensitivity.

The next step is to fasten the wired core to the support stand and suspend the magnet/mirror assembly by a thread in the center of the loop. Obtain a large sheet of white material, e.g., projection screen, white cardboard box that's been taken apart. Locate the screen 4' away from the mirror. The laser spot will shine on this screen, and magnify the movements of the mirror/magnet assembly. OK, we're almost ready to try it, but it's time for a laser safety refresher first. Please read the box on "Laser Safety" before proceeding ...

Back already? Now we can continue. The next step is to shine your laser on the Galvo's mirror from a distance of 6 inches (0.5 feet). This will give you a multiplication factor of 4/0.5 or 8 times over a 1:1 distance ratio. Now apply a small current to the wire coil, say 1.5 volts from a battery through a 100 ohm resistor. Note how far the spot is deflected on the screen, and mark it down. Reverse the leads and the spot should be deflected an equal but opposite distance. Try and halve the current and then double it to see how accurate your measuring Galvo is. At some point, close to right angles with the magnetic field, the magnet / mirror assembly will lose its linearity of measurement. Where does this happen? Can you explain it? We'd like to hear some theories. Please send them to the special Nuts & Volts P.O. Box set up for laser aficionados. The address is listed at the end of this article.

This is a good time to draw a contrast between non-directional electromagnetic energy like the magnetic field of your Galvo, and directed, coherent energy such as from a laser. Note this experiment combines both types of energy. Non-directed electromagnetic energy (common light is an example) obeys the *Inverse Square Law*

of Brightness. This means that an expanding sphere of energy from a radiating source spreads out at the square of the distance from the source. To clarify this we'll use an example: Let's say at one foot your Galvo radiates a magnetic field of one Unit. At the moment, it doesn't matter if the Unit is a Gauss or a Tesla or a Mugawug; let's just assume it's one Unit. Now at TWO feet, the intensity is 1 divided by 2 squared (2^2), or $1/4$ a Unit. At 3 feet it is $1/3^2$ or $1/9$ th Unit, at four $1/4^2$ or one sixteenth Unit and so on.

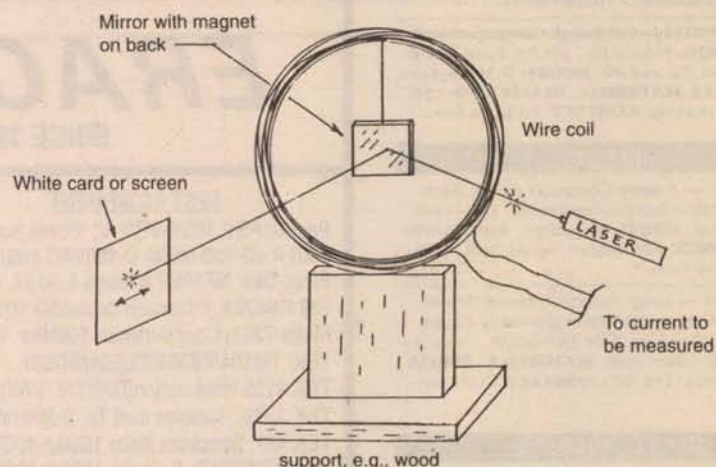
And so on. You should imagine if it were possible with an imaginary super-detector to measure your Galvo's magnetic field strength at the Moon, which is an average of 238,860 miles (or 1,261,180,800 feet) it would arrive with a strength of only 0.0000000000000000000000006287 or 6.287×10^{-19} Unit. Let us now contrast the laser, a directed form of energy, that does not spread out as a spherical wavefront. According to the Sharp Laser Diodes User's Manual: "For example, it is possible to collimate (using the appropriate lenses) a laser beam to a diameter of 1 mm, direct it towards the Moon, and achieve a beam diameter of about 200 mm on the surface of the Moon." [1] If we plug some math into those figures, we find out the laser beam arrives with a strength equal to 0.000025 or 2.5×10^{-5} of its original strength (ignoring the absorptive effects of Earth's atmosphere), a difference on the order of a hundred thousand billion times better, and well within the limits of state-of-the-art opto-electronics able to detect such a 200 mm diameter beam.

Let's formally introduce a numbering system called Scientific Notation, which most of you are already familiar with. I've been sneaking a little of it in here and there to describe large and small numbers - which you may have noticed! In the Scientific Notation system, one million, usually written out as 1,000,000, becomes $1 \times 10(6)$ or ten to the sixth power. Similarly two and a half billion is $2.5 \times 10(9)$ and one thousandth $1 \times 10(-3)$. To make it even easier, it's traditional to drop the leading digit if it's a 1.

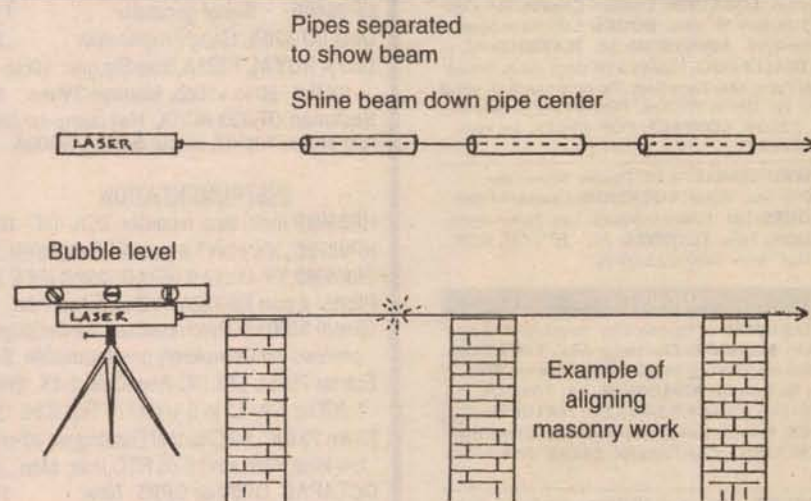
Note the digit(s) are simply displaced to the right of the decimal by the amount of a positive exponent, or to the left if the exponent is negative, like in the last example. Remember the number 10 is actually $10\{1\}$ and that one is $10\{0\}$ and 0.1 is $10\{-1\}$, and you should be all set. So one hundredth is written out as $10\{-2\}$. Scientific Notation is simpler to read once understood, so we'll be using it for very large or small numbers from here on in.

Returning to our Galvo, we see that by moving the screen further away, and the laser closer, you can increase the multiplication factor of your Galvo's optical lever by any practical amount. Your homemade Galvo demonstrates the principle of commercial versions. The big difference with commercial Galvos is they are obviously much smaller, considerably more sophisticated and hence can operate fast enough to draw pictures with a laser beam when used with a controller. Eyesight is part chemical in nature, so any beam flickering fast enough appears as a solid line due to

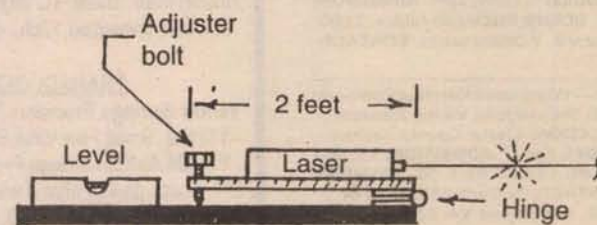
FIGURES



1

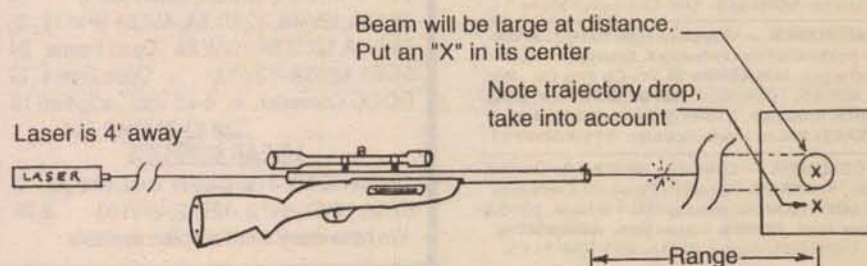


2



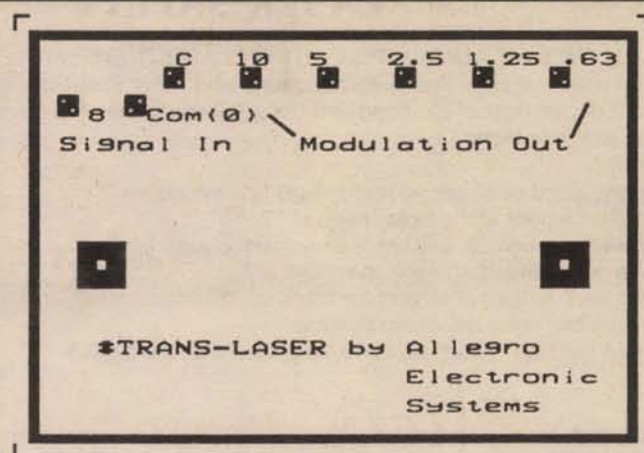
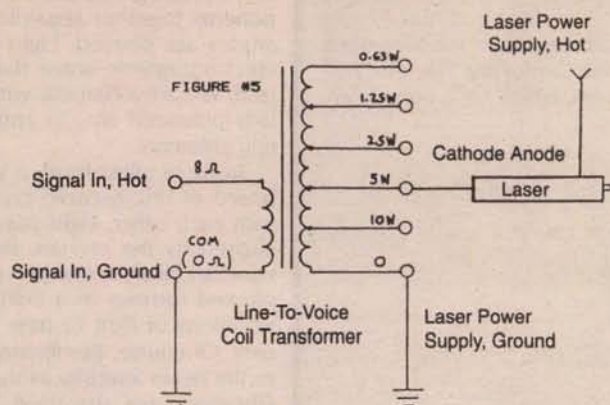
The adjuster bolt helps establish pitch, such as needed with drain pipes. With a 2 foot mount, 1/10" turn of the bolt equals a beam movement of 1/2" at 10 feet or 5" at 100 feet.

3

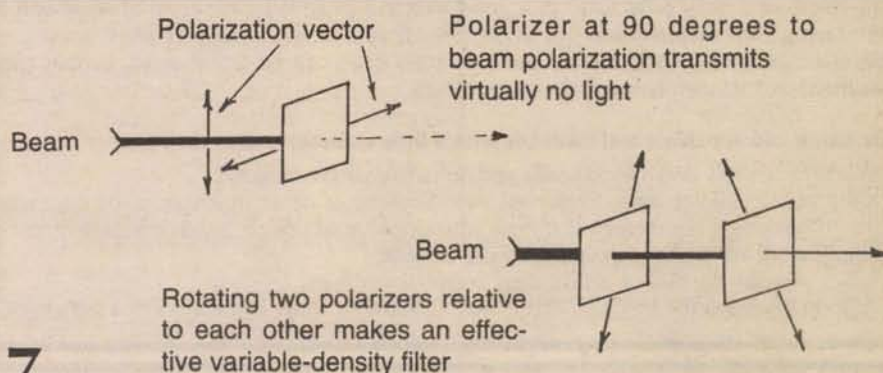
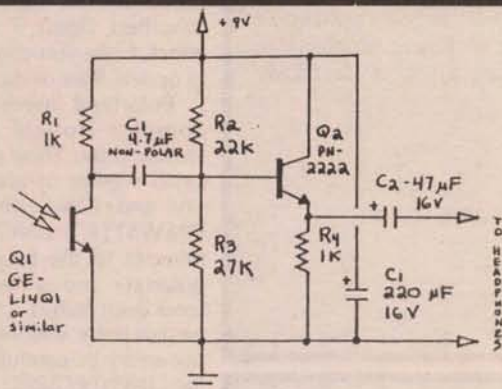


4

FIGURES



Transmitter
PC Board
Pattern



5

6

7

persistence of vision. Galvos of modest light show quality are available from MWK Industries for people who wish to experiment further.

OPTICAL ALIGNMENT USES

The laser lends itself to an excellent line-of-light indicator suitable for trueing up piping and fences, levelling construction work, sighting in weaponry, and any other application that involves a straight beam. At Figure 2 are some representations of how you can accomplish various forms of measurement with a laser. Masonry can be aligned by mounting the laser to a camera or other tripod. Using a bubble level affixed to the laser's case in exact alignment with the beam axis, levelling long stretches of work becomes easy. It's likely you will need a collimator, which is a lens assembly that enables the beam to significantly reduce its spread at a distance. Collimators are available from most laser suppliers.

Another handy application involves lining up piping. Water, drain and sewage pipes must be aligned rightwise so that they can be secured properly or leaks may develop after the pipeline is buried. In the case of waste pipes, frequently a pitch is required so it will drain properly. A laser is an ideal tool to help with construction. Shine the beam down the center of each pipe. A sheet of white computer paper will pinpoint the beam, and thus the accuracy of the pipefitting. An assembly such as the laser/level base shown in Figure 3 is a handy way to home-build a rather accurate instrument.

Rifles can be aligned more precisely using your laser. Consult Figure 4 for a sketch. Important factors here involve a good-sized bench, and careful set-up so you can shine the beam exactly down the rifle's bore. The laser should be located about 4' away from the breech end. The rifle must be clamped in a vise whose jaws are padded with a soft material to prevent them from injuring the stock. You will probably want to test fire it several times; rifles with a large recoil need more elaborate clamping techniques than mentioned; here I am relating experiences with a .22 caliber target rifle which in our neck of the woods we refer to as a "pea-shooter."

Optical alignment is a little tricky; patience will be required lining up the laser and the rifle's bore. The bore must be clean or the beam will scatter off powder residue making alignment trickier. A white card or screen is placed at whatever distance needed from the muzzle. The beam spot should be clean. If it's not, the beam is not centered down the bore, and you will have to make further adjustments.

To pre-calibrate trajectory drop at the traditional 100 yards, place the screen that distance away and align the sight so it sights at the center of the projected spot - which will be quite large at 100 yards with an un-collimated laser. Also, for long distances it's necessary to do this at dusk or dark so you can see the beam. Now, put an "X" in the center of the beam spot. Raise the sight by whatever inch amount your intended ammo drops at 100 yards - with a .22 caliber long-rifle bullet, it's 4.3 inches for one brand of ammo. Now your rifle is sighted-in for 100 yards. Replace the bolt and test fire it and you'll probably find the laser has the rifle sighted right on. Run a patch down the bore with the ramrod if laser realignment is required so the beam remains unblocked. Needless to say, a rifle-scope helps immeasurably both in the sighting-in process and for targeting. One by-product of this use is if you've got the laser aligned just off-center of the bore, it will create a neat spiral pattern that is magnified representation of the bore's rifling. To view it, hold the card just 3' away. Other patterns sometimes will appear, but they are of no use - they just show the beam is not centered in the bore.

VOICE ON A LIGHT BEAM

My father once took me to a technical fair which had a He-Ne set up to talk across a light beam. It was a pre-recorded message which extolled the wonders of light communication, and if you pulled down a lever that blocked the beam the message disappeared. At the time, it was like magic. Harrumph. We Laser Experimenters can do MUCH better than that on our own!

Helium-Neon lasers are capable of being Amplitude Modulated (AM) by a very simple means. Check out Figure 5 for proof! Anything that will vary the intensity

of the beam will AM it. This also includes such bane to the experimenter as bugs crossing the light path, yet the system shown works very well. The trick is to insert a voltage-multiplying transformer in the laser's CATHODE - never in the high voltage anode! Also, some older AC power supplies with voltage regulating circuits in the cathode won't work safely. To tell if your AC supply will work, use an Ohmmeter or the Continuity Test feature on your DMM. Connect one lead to the AC power supply ground (green wire). Connect the other to the laser cathode. You should get a zero reading (or the fractional Ohm reading of the test leads). If so, your power supply is safe. Be extra careful with scratch-built power supplies that have appeared in books and articles about laser experimentation. Many of these won't work.

A signal source such as a tape player or graphic equalizer is attached to the primary

of T1, and the cold side of T1's secondary to power supply ground. There are several secondary taps on T1, which is called a line-to-voice coil transformer. One is attached to the laser's cathode. Choose the one that works the best. Each set-up will be a little different so you will need to experiment to determine the tap that works best with your particular laser and signal source. A PC board pattern has been provided for convenience. With this particular board, it is advisable to mount the transformer on the FOIL side and solder the taps to the corresponding labeled pads. This way you connect and disconnect the laser's cathode in a jiffy. Drill an 1/8" hole in each large square for T1, and mount it using 6 machine screws, nuts and lockwashers.

Now that you have a transmitter, you need a receiver. A simple receiver design is presented at Figure 6. The heart of the circuit is the phototransistor a #GE-L14Q1 (available for under \$1 from Allegro

SOURCES

MWK Industries, 198 Lewis Court, Corona, CA 91720; ph: (909) 298-0563. Hours: 8 to 5 PST weekdays, 10-3 Saturdays. Free catalog. Source for new and used laser equipment, supplies and optics. Carries a wide variety of He-Ne and other lasers suitable for the experimenter & hobbyist.

Anderson Lasers, Inc., 2883 West Royalton Road, Broadview Heights, OH 44147. New and surplus industrial and scientific lasers & equipment. Carries high-power commercial grade equipment, not a hobbyist supplier. Professional inquiries contact: Richard Anderson, ph: (216) 237-6629, or FAX: (216) 237-0656.

Allegro Electronic Systems, 3 Mine Mountain Road, Drawer NV, Cornwall Bridge, CT 06754. Mail-order supplier of laser-related technical books. Carries laser communications and other equipment; hard-to-find electronic parts. Catalogs cost \$1 for a set.

Edmund Scientific Company, 101 East Gloucester Pike, Barrington, NJ 08007-1380; ph: (609) 573-6250. Free catalog. Supplier of a wide variety of educational and scientific equipment including lasers and an extremely comprehensive line of optics.

Midwest Laser Products, P.O. Box 2187, Bridgeview, IL 60455; ph: (708) 460-9595, FAX: (708) 430-9280. Free catalog. Carries new and used laser equipment and inexpensive start-up systems.

Be sure and mention Nuts & Volts when you contact the above suppliers so your request goes to the right department.

LASER SAFETY

It is necessary to STRICTLY OBSERVE CERTAIN PRECAUTIONS ABOUT EYE SAFETY and the high voltage power supplies used with gas lasers. The government agency that regulates lasers and other radiative devices is called the Center for Devices and Radiological Health, and is a department of the Food and Drug Administration. Here are some of their rules, which have been interpreted so it's easier for you to follow them:

- Never stare into the operating end of a laser no matter how low the power.
- Keep non-optical, stray reflectors out of the beam path.
- Avoid work environments with extremely low levels of ambient (room) light.
- Never permit a laser to be left unattended while operating.
- The laser beam should be backstopped at target (use black construction paper).
- Keep laser apparatus completely enclosed where possible.
- (This is to protect you from the high voltage power supply used with gas lasers.)
- Wear safety goggles.

This last item is rather expensive, but it's a good investment if you intend to experiment avidly and goggles will last a lifetime. If you can't afford goggles, just be a LOT more careful about getting the beam in your eyes. That includes reflections from windows, mirrors, lenses and other reflectors. It's a good idea to use an indicator lamp of some sort to show the laser's on to prevent bystanders from ogling your output beam out of curiosity. If your laser's power supply is uncovered, make a cover for it! Power supplies can deliver an extremely nasty shock, and the larger ones can be lethal under certain circumstances, particularly if you're electrically grounded and accidentally touch the output leads.

You can avoid accidents and mistakes with a little common sense such as:

- Working sensibly and methodically and not while you're fatigued.
- Keep young children away from your laser. Sometimes pets can wreak havoc on a set-up if they get curious about it, too.
- Avoid working around careless friends who would treat your scientific instrument like a play-thing.
- Damp work areas and high voltage invite trouble.
- Teach yourself the skill of anticipating potential problems.
- And do backstop the beam so that it won't accidentally enter someone's or a pet's eye.

LASER NEWS AND DEVELOPMENTS

Fantastic Laser Power Levels Available in Small Footprints

According to the April issue of R & D Magazine, it is now possible to purchase a laser that will fit on your lab's table that produces pulses in the terawatt level. Although such scientific lasers are far out of the experimenter's monetary reach, it is fascinating to learn the current world's record for a more-or-less "tabletop" laser is 55 terawatts, achieved by researchers in Limeil, France. For those of you who wish to know what this awesome power compares to, the entire electrical output of the U.S. at any one time is about 1/2 a terawatt! A terawatt is 10 to the 18th power - 10^{18} - or 1,000,000,000,000,000 Watts. Obviously, the laser is not using the whole energy of the U.S. when it fires, although for a brief instant its power level is even greater. The trick is to produce these pulses in short duration. Taking an average industry figure, these extremely high power pulses last less than 100 femtoseconds: 10^{-13} in scientific notation. That's .000000000001 second folks. 100 femtoseconds is such a short time that the human mind can't directly grasp it. But a thought experiment helps. Imagine 100 femtoseconds is to one second as one second is to 317,098 years.

You may inquire: what use are such ultra-high powers and ultra-short durations? Answer the researchers: many. How about optical computing and communications? Or laser-influenced chemistry? Electronics buffs will be interested in real-time monitoring of integrated circuits. Since the pulses are equivalent timewise to a signal of 10,000 gigahertz, this writer speculates that it may be possible to view and influence small groups of individual electrons flowing through the gates of IC's, thus opening up new advances in this branch of science. Such powerful laser pulses could be used to accelerate atomic particles to energies a thousand times that which will be available from the gigantic Superconducting Supercollider, according to R & D Magazine. By utilizing techniques to generate optical harmonics, scientists believe they can create a fast pulse X-ray laser which operates at a much shorter wavelength than state-of-the-art lasers. The advantage would be enabling researchers to watch the biochemical processes that occur inside living cells in real time, thus expanding our knowledge of how life processes work, without killing the cells under study - an unfortunate by-product of using present-day electron microscopes.

Electronic Systems) or similar. Modulated light shining on Q1 causes it to pull resistor R1 towards ground generating an AC signal that is passed by non-polar electrolytic capacitor C1. (Use two back-to-back 10 uF capacitors connected at their (-) terminals if you can't locate a non-polarized type.) That AC signal is current amplified by Q2 and its associated bias resistors which set its operating parameters as a low-distortion common-emitter amp. The amplified current is now fed through coupling capacitor C2 into a pair of Walkman or similar headphones. While the gain of the circuit isn't so great, its simplicity is!

Note you can use your VCR remote control to check out the circuit. I can hear mine about 4' away in subdued room light, and its tone sounds vaguely musical. This

circuit is prone to "swamping" - in other words, over-driving Q1. Expand the beam for best results to about 1/2", and jiggle the alignment of the expanded beam on Q1 until the best sound comes across.

I have a receiver circuit that features a REAL high gain. Plus a nifty PC board pattern to go with it. With a proper optical system that circuit should enable laser communication for miles in clear air. Anyone want to see it in print? If so, drop us a line at the Laser P.O. Box set up for Nuts & Volts readers. Please write directly to that box so we can do the work and save Nuts & Volts from forwarding your letters!

POLARIZATION

Polarization is an important aspect of

laser light that we'll touch on briefly with perhaps more about that topic in a future article. We note the phrase ELECTROMAGNETIC wave as applied to light and lasers. This means light has an ELECTRIC and MAGNETIC component, and to simplify it, a light wave is composed of the two components simultaneously propagating through space and vibrating at right angles to each other. While this sounds counter-intuitive (you can't bend light with either a magnet or electric field no matter how powerful), nevertheless it is provable by modern theory. So the angle of the ELECTRIC component hidden in the properties of light itself can be manipulated by a POLARIZER. In a way, it's similar to bending light with a prism except in this case you are manipulating the angle of vibra-

tions hidden within light, and filtering out those that are not desired, the difference of a prism being you are bending both components together regardless of how their angles are phased. Light is not the only electromagnetic wave that can be polarized. We are all familiar with the term circularly polarized etc., as applied to transmitting antennas.

In its simplest form, a polarizer is composed of microscopic crystals, all aligned with each other. Light passing through it is aligned by the crystals, like the slats in a venetian blind, or less precisely, like straight plowed furrows in a field, permitting the vibrations of light to pass in one direction only. Of course, this filtering effect decreases the beam intensity as the non-directional vibrations are absorbed. The further the polarizer is "crossed" to the natural alignment of the light, the more light is absorbed. Figure 7 shows a sketch of this effect. Note you can make a variable density optical filter using two polarizers.

Polarized lasers are primarily used in complex optical experiments and in Holography. They can be identified by a small wedge of glass inside the tube on one end. Glass, when placed precisely at BREWSTER'S ANGLE of 56 degrees, 39 minutes to the beam axis, functions as a polarizer and is hence used inside polarized laser tubes. Some lasers have this wedge quite well hidden. In this case it is necessary to carefully look into the bore of the UNENERGIZED laser and you probably will see a rectangular wedge image itself in the center of one of the mirrors. Experimenters can try polarizing their own lasers by purchasing one of the many available from Edmund Scientific. I use a plastic sheet polarizer for experiments, which is inexpensive and operates well for typical work.

CONCLUSION

Well, we certainly hope you've enjoyed the last two articles on Lasers! It has sure been fun writing them - but there are many, many exciting topics yet unexplored. There are some very good books on lasers available from a well-stocked library and by mail-order. With enough learning, logical patterns in Nature emerge and give rise to an instinct of order. Perhaps that instinct is at the root of humanity's zest for learning and technology. The Laser surely can be considered one of the most powerful tools ever available to aid our quest to understand the various blueprints of Nature. NV

CLOSING QUOTE:

"The Heavens themselves, the planets and this center Observe degree, priority and place, Insisture, course, proportion, season, form, Office and custom, in all line of order."

William Shakespeare

Technical reference:

1. Sharp Laser Diode User's Manual, page 16, pub. Sept. 88, Sharp Corp.

While we received a good deal of mail, the results aren't quite in about "columnizing" lasers and laser experimentation on a monthly basis. We still need to know whether you would like to read about lasers regularly. Many thanks to those who have written, and some of you came up with great ideas! Any others out there? Fire up the old quill pen and calligraph your opinions and ideas to: The Laser Experimenter, P.O. Box 74, Cornwall Bridge, CT 06754. Comments, constructive criticisms and suggestions are most welcome. Individual replies to questions regrettably are not possible due to time constraints, but we anticipate answering some of your questions in print.

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Atari ST RGB Monitor. Model SC1224
Analog RGB Input. Din 15HD
Connector (Refurbished).....\$125.00

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w/stand. New in box.....\$59.00

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41024.....\$4.00
1024 (1 Meg) x 8 SIMM -10.....\$27.00 -12.....\$25.00
COMPAQ LTE 2Meg (2048K) Module.....\$75.00

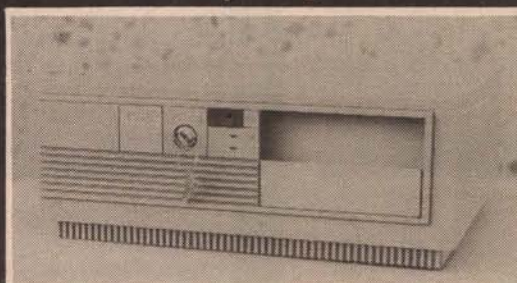
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Refurbished. Uses 3.5" Wide paper. Has
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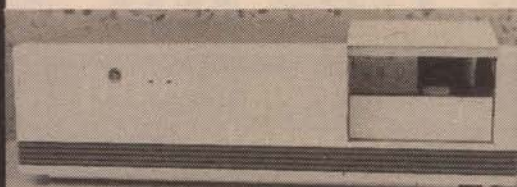
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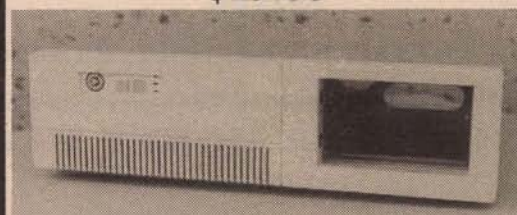
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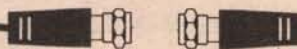
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7434	74179	.230	74LS43	34	74LS224	69			74HC109	59	74HC820	79	4067	69	4771	.60	LM586	.69	LM3202	1.09	PN2907	.20
7435	74180	.89	74LS44	35	74LS225	69			74HC110	59	74HC821	79	4068	69	4772	.60	LM587	.69	LM3203	1.09	PN2907	.20
7436	74181	.209	74LS45	34	74LS226	69			74HC111	59	74HC822	79	4069	69	4773	.60	LM588	.69	LM3204	1.09	PN2907	.20
7437	74182	1.00	74LS46	34	74LS227	69			74HC112	59	74HC823	79	4070	69	4774	.60	LM589	.69	LM3205	1.09	PN2907	.20
7438	74183	.89	74LS47	34	74LS228	69			74HC113	59	74HC824	79	4071	69	4775	.60	LM590	.69	LM3206	1.09	PN2907	.20
7439	74184	.89	74LS48	34	74LS229	69			74HC114	59	74HC825	79	4072	69	4776	.60	LM591	.69	LM3207	1.09	PN2907	.20
7440	74185	.349	74LS49	34	74LS230	69			74HC115	59	74HC826	79	4073	69	4777	.60	LM592	.69	LM3208	1.09	PN2907	.20
7441	74186	.89	74LS50	34	74LS231	69			74HC116	59	74HC827	79	4074	69	4778	.60	LM593	.69	LM3209	1.09	PN2907	.20
7442	74187	.89	74LS51	34	74LS232	69			74HC117	59	74HC828	79	4075	69	4779	.60	LM594	.69	LM3210	1.09	PN2907	.20
7443	74188	.89	74LS52	34	74LS233	69			74HC118	59	74HC829	79	4076	69	4780	.60	LM595	.69	LM3211	1.09	PN2907	.20
7444	74189	.89	74LS53	34	74LS234	69			74HC119	59	74HC830	79	4077	69	4781	.60	LM596	.69	LM3212	1.09	PN2907	.20
7445	74190	.89	74LS54	34	74LS235	69			74HC120	59	74HC831	79	4078	69	4782	.60	LM597	.69	LM3213	1.09	PN2907	.20
7446	74191	.89	74LS55	34	74LS236	69			74HC121	59	74HC832	79	4079	69	4783	.60	LM598	.69	LM3214	1.09	PN2907	.20
7447	74192	.89	74LS56	34	74LS237	69			74HC122	59	74HC833	79	4080	69	4784	.60	LM599	.69	LM3215	1.09	PN2907	.20
7448	74193	.89	74LS57	34	74LS238	69			74HC123	59	74HC834	79	4081	69	4785	.60	LM600	.69	LM3216	1.09	PN2907	.20
7449	74194	.89	74LS58	34	74LS239	69			74HC124	59	74HC835	79	4082	69	4786	.60	LM601	.69	LM3217	1.09	PN2907	.20
7450	74195	.89	74LS59	34	74LS240	69			74HC125	59	74HC836	79	4083	69	4787	.60	LM602	.69	LM3218	1.09	PN2907	.20
7451	74196	.89	74LS60	34	74LS241	69			74HC126	59	74HC837	79	4084	69	4788	.60	LM603	.69	LM3219	1.09	PN2907	.20
7452	74197	.89	74LS61	34	74LS242	69			74HC127	59	74HC838	79	4085	69	4789	.60	LM604	.69	LM3220	1.09	PN2907	.20
7453	74198	.89	74LS62	34	74LS243	69			74HC128	59	74HC839	79	4086	69	4790	.60	LM605	.69	LM3221	1.09	PN2907	.20
7454	74199	.89	74LS63	34	74LS244	69			74HC129	59	74HC840	79	4087	69	4791	.60	LM606	.69	LM3222	1.09	PN2907	.20
7455	74200	.89	74LS64	34	74LS245	69			74HC130	59	74HC841	79	4088	69	4792	.60	LM607	.69	LM3223	1.09	PN2907	.20
7456	74201	.89	74LS65	34	74LS246	69			74HC131	59	74HC842	79	4089	69	4793	.60	LM608	.69	LM3224	1.09	PN2907	.20
7457	74202	.89	74LS66	34	74LS247	69			74HC132	59	74HC843	79	4090	69	4794	.60	LM609	.69	LM3225	1.09	PN2907	.20
7458	74203	.89	74LS67	34	74LS248	69			74HC133	59	74HC844	79	4091	69	4795	.60	LM610	.69	LM3226	1.09	PN2907	.20
7459	74204	.89	74LS68	34	74LS249	69			74HC134	59	74HC845	79	4092	69	4796	.60	LM611	.69	LM3227	1.09	PN2907	.20
7460	74205	.89	74LS69	34	74LS250	69			74HC135	59	74HC846	79	4093	69	4797	.60	LM612	.69	LM3228	1.09	PN2907	.20
7461	74206	.89	74LS70	34	74LS251	69			74HC136	59	74HC847	79	4094	69	4798	.60	LM613	.69				

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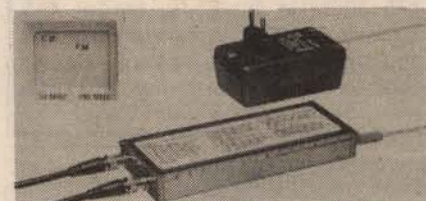
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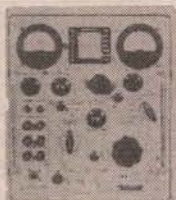
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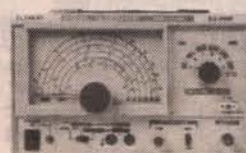
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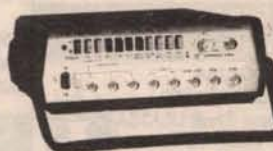
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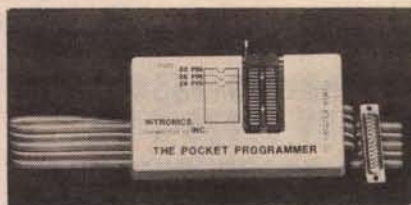
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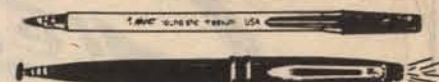
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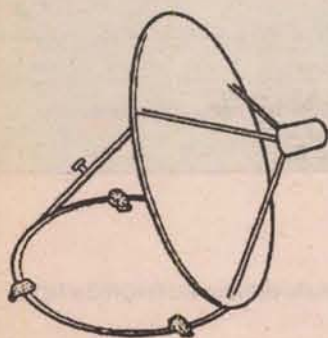
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AMATEUR

ROBOTICS

by Karl Lunt

Last month I described a small 68hc11-based computer board that will serve as the core of future projects. The circuit is quite simple to build, and should go together in just a few evenings. You can find the parts list for this project in last month's column. Refer to the accompanying 68hc11 schematic.

Start by cutting several 2"-long pieces of 30-gauge wirewrap wire and stripping 1/4" of insulation from each end. You will use these wires in making point-to-point connections on the circuit board. I find that having a small bag of these wires already prepped makes the actual construction less tedious.

You can also buy tubes or bags of wirewrap wire already pre-cut and stripped; Active and Digi-Key are just two suppliers to contact. These wires will be prestripped for wirewrap, so you will need to cut the exposed ends to length before using them for point-to-point wiring.

You will build the 68hc11 computer circuitry on a Radio Shack experimenter's board (276-149). The following paragraphs refer to holes in this board using the coordinates silk-screened on the board's component side.

Position the 8.0 MHz crystal so its leads fit into holes B3 and D3. Similarly, place a 22 pf capacitor at B1 and C1, and another at D1 and E1. Finally, put the 5.1M ohm resistor at B2 and E2.

Use the leads of each component to wire these parts together per the schematic. Leave the crystal's leads untrimmed; you will later connect these leads directly to the PLCC socket. You should not need to use any wirewrap wire for these connections. Work carefully and use good soldering technique.

Next, position the 52-pin PLCC socket so pin 1 fits into hole G5. This should leave the socket placed firmly against the crystal, with only the A-row of pins exposed on the left side of the board. Carefully solder the crystal's leads to pins 7 and 8 on the socket and trim the wires.

Make sure you don't accidentally connect either crystal lead to any other pin on the PLCC socket. Refer to the accompanying PLCC socket layout diagram for pin locations. Note that this diagram shows the PLCC socket as viewed from the BOTTOM.

Install a 10K ohm SIP resistor pack by placing pin 1, marked with a painted dot, in hole A6. Wire two SIP resistors to pins 18 and 19 on the 68hc11 socket. You may use any pins of the SIP you like except pins 1 and 8. Pin 1 must be reserved; you will later wire it to +5v as a pullup.

Install a 0.1 uf capacitor in holes A14 and B14. Connect the capacitor lead at A14 to pin 8 of the SIP resistor pack. Wire this junction to pin 17 of the 68hc11 socket. The remaining capacitor lead will later be wired to ground.

Install a 4-pin MTA post header (male connector) with pin 1 in hole O2 and pin 4 in hole L2. As with all my MTA connectors, pin 1 is on the left as you view the connector from the front; the locking tab will be behind the pins in this orientation. This MTA connector will carry the Rxd and Txd serial signals from the 68hc11.

Install a 6-pin jumper block (arranged as 2x3 pins) with the center pins of each row in holes H1 and H2. Note that you may replace this component with a miniature DPDT switch, if available. Wire the jumper block and MTA connector per the schematic.

Install a 2-pin MTA post header with pin 1 in hole O6 and pin 2 in hole O5. Pin 1 will be ground and pin 2 will be +5v. Wire these two pins to all remaining ground and +5v pins. Remember to wire pins 2, 3, and 51 of the 68hc11 socket to ground. Also be very careful when wiring pin 52 of the 68hc11 socket. This wire connects to +5v; make sure you don't accidentally short it to any of the grounded pins nearby.

This completes the first phase of construction. Use a digital voltmeter (DVM) to verify that the two pins of the power connector are not shorted together. Also verify the ground and +5v wiring by checking for continuity between the proper power connector pin and all other pins in that network.

After you have checked all connections and corrected any problems, you can install the 68hc11a1 MCU in its socket. To do this, first pick up the computer board and hold it so your skin is directly in contact with the ground pin on the power connector.

Pick up the 68hc11 MCU chip with your other hand and carefully orient it so the tiny

dot on the chip's package aligns with the pin 1 marking on the PLCC socket's frame. Place the 68hc11 chip so it rests flat on the socket's opening, sitting on the tiny silver leaves of the socket. Very carefully press the chip down into the socket. The chip must sit flat in the socket; if it is crooked or angled in any way, carefully remove it and retry.

The next phase of construction involves the MAX232 chip and the RS-232 connector called out in last month's parts list. This task requires you to carefully build the MAX232 circuitry inside the plastic shell for the RS-232 connector. Use a solder-tail socket, insulated wire, and short leads on all components. Refer to the accompanying schematic.

Bring the four signals (GND, +5v, Rxd, and Txd) out from the RS-232 shell to the appropriate pins of a 4-pin MTA receptacle (female connector). This connector will later connect to the matching 4-pin MTA post header described above. Be sure to verify signal wiring on both of these connectors as you wire the 4-pin receptacle.

If you feel that you just cannot build this circuitry into such a small space, you may choose to wire this section on a small piece of experimenter board, such as half of Radio Shack's 276-148. You will then have to find a suitable enclosure and cables.

Regardless of your construction method,

make sure you keep the leads between the computer board and the MAX232 circuitry no longer than 12 inches.

Note that you can replace the MAX232 and its four capacitors with a single MAX233 chip, available from some of the larger mail-order houses. This chip takes a different socket than the MAX232, and the pinout is obviously different. Consult the MAXIM book for details on wiring in this chip.

Testing your board

This computer board uses four AA-size NiCd batteries as its power supply. The Motorola spec claims a maximum operating voltage of 7.0 volts DC for this chip, so you could conceivably run it from four alkaline cells. However, I will stick with the NiCds in my projects.

Connect the battery holder's black wire to pin one of a 2-pin MTA-style female connector (receptacle). Similarly, connect the battery holder's red wire to pin two of this connector. Install four AA-size NiCd batteries in the battery holder; make sure you install the batteries properly.

Next, configure the 68hc11 computer board for download mode. You do this by setting the two jumpers so that the Rxd and Txd pins are tied to the 4-pin MTA connector, rather than to the pullup resistor (refer to the schematic). Note that both jumpers must be

Pin Assignments for the 68hc11A1

								[52-pin PLCC package]			
	47	49	51	1	3	5	7	1 Vss (GND)	27	PA7/PA1/OC1	
	○	○	○	○	○	○	○	2 MODB	28	PA6/OC2/OC1	
	48	50	52	2	4	6	9	3 MODA	29	PA5/OC3/OC1	
46 ○	○	○	○	○	○	○	○	4 STRA	30	PA4/OC4/OC1	
								5 E	31	PA3/OC5/OC1	
								6 STRB	32	PA2/IC1	
44 ○	45 ○						○ 11	7 EXTAL	33	PA1/IC2	○ 10
								8 XTAL	34	PA0/IC3	
42 ○	43 ○						○ 13	9 PC0/AD0	35	PB7/A15	○ 12
								10 PC1/AD1	36	PB6/A14	
40 ○	41 ○						○ 15	11 PC2/AD2	37	PB5/A13	○ 14
								12 PC3/AD3	38	PB4/A12	
38 ○	39 ○						○ 17	13 PC4/AD4	39	PB3/A11	○ 16
								14 PC5/AD5	40	PB2/A10	
36 ○	37 ○						○ 19	15 PC6/AD6	41	PB1/A9	○ 18
								16 PC7/AD7	42	PB0/A8	
34 ○	○	○	○	○	○	○	○	17 *RESET	43	PE0/AN0	○ 20
	35	32	30	28	26	24	22	18 *XIRQ	44	PE4/AN4	
	○	○	○	○	○	○	○	19 *IRQ	45	PE1/AN1	
	33	31	29	27	25	23	21	20 PD0/RXD	46	PE5/AN5	
								21 PD1/TXD	47	PE2/AN2	
								22 PD2/MISO	48	PE6/AN6	
								23 PD3/MOSI	49	PE3/AN3	
								24 PD4/SCK	50	PE7/AN7	
								25 PD5/*SS	51	Vrl	
								26 Vdd (+5V)	52	Vrh	

moved to the same side; the 68hc11 will not respond otherwise.

Plug the 4-pin serial connector from the MAX232 circuitry onto the computer board's 4-pin serial connector. Plug the DB-25 connector of the MAX232 circuitry onto the proper serial cable to your PC. Plug the battery's 2-pin connector onto the computer board's 2-pin power connector.

Install the PCBUG11 software in a suitable directory on your PC. Start the program by entering the command:

```
pcgub11
```

The program will ask you a series of questions to determine your 68hc11 configuration and which COM port you are using. After completing the questions, jot down the command line that PCBUG11 displays; you can then type the command directly the next time you want to run PCBUG11. For example, my PCBUG11 command line is:

```
pcbug11 -a port=2
```

because I am using a 68hc11a1 and my computer board is hooked to COM2.

PCBUG11 will attempt to connect to the 68hc11 computer board and download a small program, called a "talker." If PCBUG11 cannot complete this connection, it will provide an error message. In this case, you must troubleshoot your RS-232 connections.

This problem could be caused by a short or miswire in the MAX232 circuitry. It might also be caused by a crosswired RS-232 serial cable; if necessary, use a null-modem cable that swaps pins 2 and 3 of the RS-232 cable.

You can also try adding a small modification to the wiring on your DB-25 connector. Using a short length of bare wire, carefully connect pins 4, 5, and 6 together inside the connector's shell. This change effectively tells the PC that the equipment hooked to the serial port is always ready to receive data.

Another source of problems could be a miswired 68hc11 computer board. If you have an oscilloscope or logic probe handy, use it to verify that an 8 MHz signal appears at pins 7 and 8 of the 68hc11 socket. If this signal is missing, double-check your battery connections, crystal wiring, and 68hc11 installation.

After PCBUG11 has established communications with the 68hc11 computer, you can begin exploring your new computer's resources. Refer to the PCBUG11 USER'S MANUAL (Motorola M68PCBUG11/D2) for details; you can order a free copy of this manual by following the directions given in last month's column.

PCBUG11 contains a terse but adequate set of help instructions. You can get help at any time by typing HELP at the command prompt and pressing Enter.

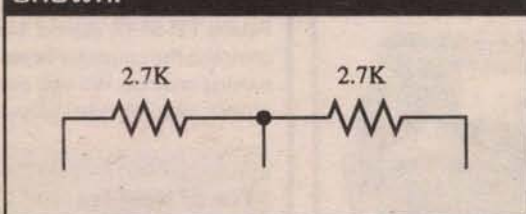
Exploring the 68hc11

Start by setting hexadecimal as PCBUG11's default number base:

```
control base hex
```

Since you will use hexadecimal numbers almost exclusively, this command removes the need to add a '\$' in front of all hexadecimal numbers (Motorola uses a '\$' prefix to indicate hex numbers).

Replace servo potentiometer with two resistors wired as shown.



PORTC as an output line. The DVM will likely show a value very close to 0 volts. Now, anything you write to bit 0 of PORTC will appear on pin 9. If you enter:

The 68hc11 contains 256 bytes of RAM, starting at address \$0000 and running to \$00ff. You can look at the contents of this RAM by entering:

```
md 0 ff
```

PCBUG11 will display the requested addresses in hex.

You could try changing any of these addresses with the mm command; for example:

```
mm 10 a5
```

would write the byte \$a5 into address \$0010. However, PCBUG11 uses quite a bit of the 68hc11's RAM, and writing values into that RAM will probably crash PCBUG11. If that happens, simply turn off the 68hc11's power, reconnect the power, then enter the PCBUG11 command:

```
restart
```

PCBUG11 should then be able to reconnect to the 68hc11 computer.

The 68hc11 also contains a number of I/O registers, at addresses \$1000 to \$103f. These registers behave very much like memory addresses; you can read from them just as if they were memory. Some registers also control output lines or internal chip resources; you can alter these registers by simply writing to them as if they were memory addresses.

For example, the 8-bit bidirectional I/O port PORTC appears at address \$1003; the eight matching I/O lines appear on the 68hc11 as pins 9 through 16.

The direction of each I/O line for PORTC is controlled by a corresponding bit in address \$1007, which is PORTC's data direction register (DDRC). If a particular bit in DDRC is set to 0, the matching bit in PORTC is configured as an input line. If a bit in DDRC is set to 1, the matching PORTC bit is configured as an output line. The power-on default for the bits in DDRC is 0; this initializes all PORTC pins to be inputs.

You can change the configuration of any PORTC I/O line at any time by simply setting the proper bit in DDRC to the necessary state. To experiment with the

PORTC I/O lines, connect a DVM between ground and pin 9 of the 68hc11's socket. You should read a very low voltage.

Now, use the command:

```
ms 1007 1
```

to configure bit 0 of PORTC as an output line. The DVM will likely show a value very close to 0 volts. Now, anything you write to bit 0 of PORTC will appear on pin 9. If you enter:

```
ms 1003 1
```

pin 9 will output 5 volts. If you enter:

```
ms 1003 0
```

pin 9 will read 0 volts. You can control other bits of PORTC with similar changes to DDRC and PORTC.

68hc11 assembly language

The simplest way to start writing software for the 68hc11 is by using PCBUG11's built-in assembler. You activate the assembler with a command such as:

```
asm <addr>
```

where <addr> is an address in the 68hc11's memory space where you want your assembly language program to start.

Since PCBUG11 is using nearly all the 68hc11's available RAM, you have to write your assembly language programs into the 68hc11's EEPROM at addresses \$b600 to \$b7ff. Before you do that, however, you have to tell PCBUG11 where the EEPROM exists. You do this with the command:

```
eeeprom b600 b7ff
```

EEPROM.

Now enter the assembly language line:

```
<sp>ldaa #55
```

(The <sp> means to enter a space before the ldaa; otherwise, PCBUG11 will think you want to declare a label called "ldaa.")

Be sure you start each line you enter with CTRL-END, to erase the text initially displayed by PCBUG11. If not, PCBUG11 will tack the remainder of the original text onto whatever you enter and the resulting text will probably be an error.

If you entered the line properly, PCBUG11 will display your entry as:

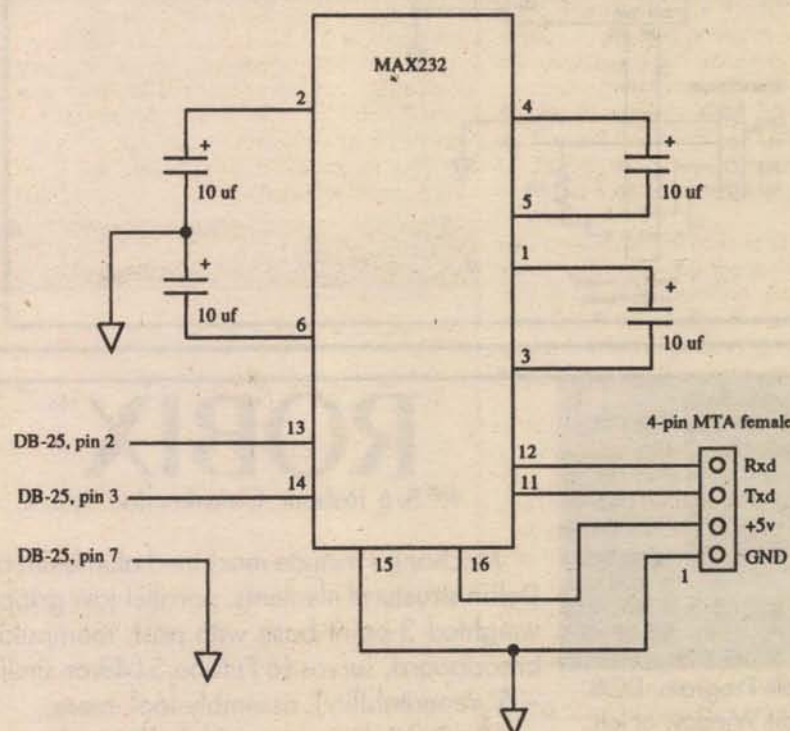
```
B600 86 55
```

which, in 68hc11 machine language, means "load accumulator A with the value \$55." Note that since the default number base is hexadecimal, PCBUG11 assumed hex instead of a decimal 55.

When later executed, this instruction will put the value \$55 in accumulator A, one of the two 68hc11 8-bit accumulators. Next, enter:

```
<sp>adda #2d
<sp>rts
ESC
```

Schematic for RS-232 level-shifter



registers. You should see the number \$82 in register A.

This is only the most basic beginning in exploring the 68hc11 MCU. To get a better grasp on what this chip offers, consult the "Mobile Robots" book, described in last month's Amateur Robotics column.

Another good source of 68hc11 material is "Single- and Multiple-Chip Microcomputer Interfacing," by G. J. Lipovski (Prentice-Hall, Englewood Cliffs, NJ, ISBN 0-13-810557-X). I was able to get this book from the Motorola literature center; contact Motorola or your local Motorola Field Application office for details.

Be sure to get copies of the PCBUG11 manual and the 68hc11 Reference Manual (M68HC11RM/AD).

Additionally, I have found the 68hc11 Programming Reference Guide

(MC68HC11A8RG/AD) to be very helpful. It is a shirt-pocket sized collection of information on register assignments, assembly language opcodes, and other important details.

Using servos

My previous robots all used DC gearhead motors for moving about. These motors did the job; they moved the 'bot. But they were very large, heavy, and power-hungry. Since this computer board is tiny, light, and uses only about 10 mA of current, I decided to look for another type of motor.

Marvin Green of the Portland Area Robotics Society (PARTS) uses modified R/C hobby servo motors on most of his robots. I have built two robots using his techniques, and pass his ideas along to you.

In its unmodified form, an R/C hobby servo motor (or servo) will position a wheel or adapter at a selected point within an arc of about 270 degrees. The exact position of the wheel depends on the width of a positioning pulse that you (or your computer) supply.

A servo has three wires coming out of its case. On the Futaba FP-S148 servo, these wires are +5V (red), GND (black), and CONTROL (white). These wires terminate in a small, black connector that fits perfectly onto a 3-pin MTA-style male connector.

The +5V and GND lines carry +5 volts DC and ground, respectively. The CONTROL line carries a short pulse that the servo uses to position its output wheel.

This pulse is usually anywhere from 0.7 to 1.7 msec in duration. The shortest pulse causes the servo to rotate its wheel fully in one direction; the longest pulse will rotate the wheel fully in the opposite direction. A pulse of the proper duration (about 1.2 msec in this example) will rotate the wheel until it is centered in its arc.

As mentioned above, the servo only rotates through about 270 degrees of arc. How can we use such a servo to drive a robot's wheel, which must rotate continuously in either direction as needed?

The servo's arc is defined by a mechanical stop or spur, molded into one of the gears inside the servo. If the spur is cut away or trimmed so it no longer functions, the servo's output shaft will rotate in a complete circle.

The servo also uses a small internal potentiometer, linked to its output shaft, to tell when the output shaft has reached the desired position. By replacing this potentiometer with a suitable pair of resistors, we can fool the servo into thinking it has never reached the target position. Thus, it will continue to rotate in the selected direction until told to stop.

You can follow these instructions for modifying a Futaba FP-S148 servo motor. I chose this motor for several reasons. First, the modification is fairly simple; some motors (notably the low-end Hobbico servo) are too much trouble to modify.

Second, this motor is cheap (about \$15 mail order from Tower Hobbies, slightly more at your local hobby store) and easy to find.

Finally, it packs about 42 oz-in of torque while only drawing about 8 mA of current. This, in turn, lets me build a tiny, working

robot that only uses about 30 mA (total!) from a set of AA-size batteries.

Modifying a Futaba FP-S148 Hobby Servo Motor for Use as a Robot Motor

In the following instructions, "front" means the part of the motor case that encloses the motor's output shaft (and has the Futaba label on it); "back" means the opposite side of the motor case.

You will need:

- Jeweler's screwdrivers (Phillips)
- Small solder iron
- Solder sucker
- Needle-nose pliers
- Diagonal cutters
- Two 2.7K ohm, 1/4-watt resistors (you could probably use 2.2K ohm resistors in a pinch; those are Radio Shack 271-1325)
- Exacto knife

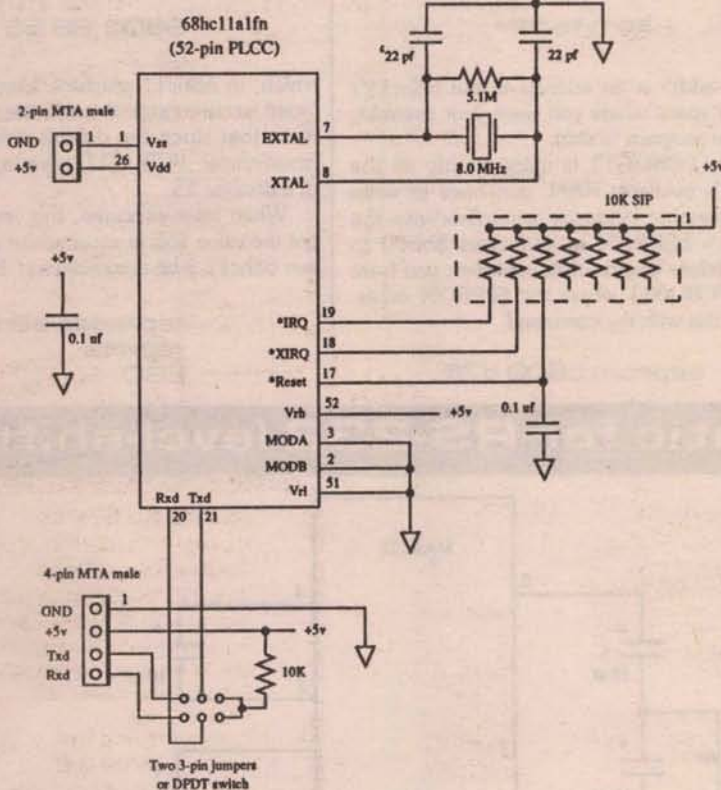
1. If your motor already has some form of mechanical coupler device screwed onto the end of the output shaft, remove it.
2. Remove the four screws from the back of the case.
3. Remove the front and back covers.
4. Remove the nylon center (top) gear and nylon gears on the output shaft and motor shaft. Work carefully so as not to remove any of the white gear grease when handling the nylon gears.
5. Using diagonal cutters and an Exacto knife, carefully trim and remove the nylon spur on the surface of the large output gear. This spur normally limits the servo's movement to an arc of about 270 degrees. Make sure you remove the spur completely. You must not leave any chunks of nylon that might prevent the output gear from rotating freely.
6. Pry off the bronze sintered bushing from the plastic hub around the potentiometer (pot) shaft.
7. Remove the two small screws on either side of the motor shaft.
8. Firmly press on the pot's shaft to push it back through the servo's case. This should push the pot and the printed circuit board (PCB) out the back of the case.
9. Remove the pot from the PCB by carefully heating its connections, then removing the excess solder with a solder sucker. Work carefully and do not damage the PCB's traces.
10. Install two 2.7K resistors, wired in series, in place of the pot. The two resistors will appear to the servo's circuit as a 5K pot rotated to its center position. Refer to the accompanying schematic.

Make sure you install the junction of the two resistors in the center pad on the PCB. Trim the leads so the resistors will fit inside the case when you later reassemble the motor. Make sure you don't accidentally short any traces on the underside of the PCB when you solder the resistors in place.

11. Carefully reassemble the servo motor. Simply reverse the above disassembly instructions.

Perform the above modification on two Futaba FP-S148 servos. Next month, we will complete the computer board's wiring and begin moving motors. We will also start on our first project using this new computer; RoboPet II. **NV**

Basic schematic for the 68hc11 robot computer



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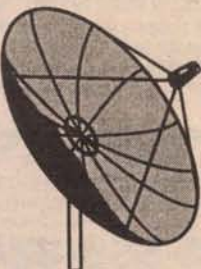


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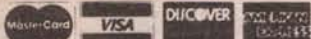
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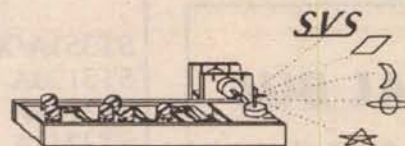
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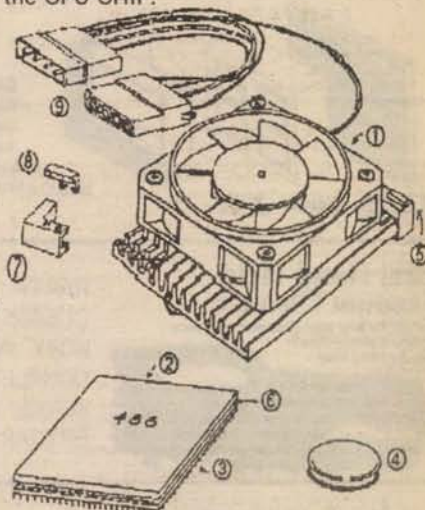
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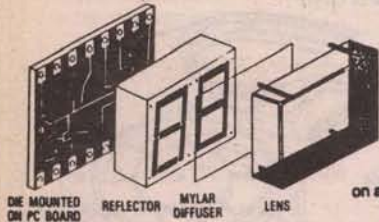
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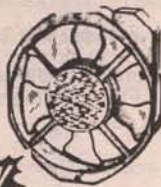
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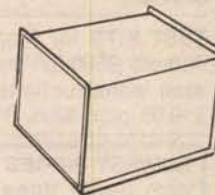


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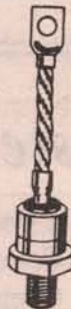


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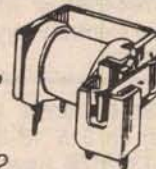


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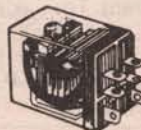
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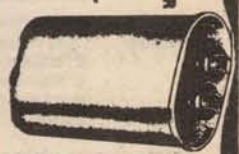
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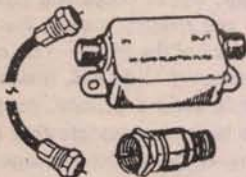
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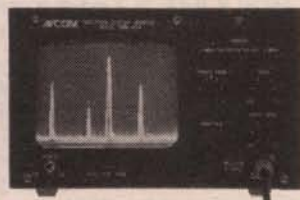
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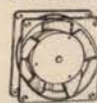
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SPREAD SPECTRUM SPOTLIGHT

by Randy Roberts

CURRENT SPREAD SPECTRUM EVENTS & MORE SS HARDWARE

Spread Spectrum (SS) and Wireless communications are very much in the news lately. The latest consumer electronics shows have featured Tandy's Zoomer, HP's 300 and Apple's Newton PDAs (Portable Digital Assistants). The FCC has almost made the 915 MHz ISM (Industrial, Scientific and Medical) band useless with its latest NRPM (Notice of Proposed Rulemaking). Even NSA and the Executive branch are making news (or waves, whichever way you look at it) with the announcement of the latest government policy on wired or wireless computer data encryption.

To help the reader through this maze, this month we will highlight some of the most important current events involving wireless and SS. Then we will step onto the soap-box to discuss our viewpoint on the "Clipper Chip" data encryption issue. We will also describe Western Multiplex's latest wideband SS hardware and mention a new SS offering from ALPS Electric. Finally, we present our views on the future direction(s) that SS hardware may take.

INTRODUCTION:

Ever been to a party where there are 15 to 30 people all trying to talk at once? Well, some people have the tendency to just try to talk louder, to be heard over the background din of other conversations. This "shouting" technique is much like the TDMA digital cellular telephone method of sharing our present frequency spectrum. A better and more effective method of being heard at this kind of party is for each separate conversation to be carried on, very softly, in a different language.

Spread Spectrum and CDMA use different codes, not different languages. The quietness, or whispering effect, is achieved in CDMA by careful adjustment of transmitter output power levels. QUALCOMM, Inc., of San Diego has found out through international field tests that CDMA can outperform TDMA (and the IS-54 digital specified standard cellular telephone) by two or three to one in bandwidth and user capacity.

As novel as SS and CDMA may seem, the

whispering in different languages at a party makes some basic, logical sense — doesn't it? This logic and the actuality of performance improvements through the use of Spread Spectrum has made the technology very popular. However, the following current events present some of the roadblocks that SS technology faces on the way to every man's market.

FCC'S LATEST "DIRTY TRICK"

According to the *W5YI Report*, Vol. 15, Issue #7, April 1, 1993 — On March 11th, the FCC (in a NRPM with comments due in June, 1993) said they would be permanently allocating shared use of the 902-928 MHz band to Automatic Vehicle Monitoring (AVM) systems (used to locate and track vehicles using non-voice methods and to relay information to and from vehicles). The FCC proposed to expand the service to encompass location of all objects, animate and inanimate and to allow licensees to provide service on a private carrier basis to individuals, the federal government and business band users.

The AVM Service will be renamed the *Location and Monitoring Service (LMS)* which the FCC defines as the use of non-voice signaling methods from and to radio units to make known the location of such units.

The FCC suggested that wideband LMS systems be licensed on the 904-912 and 918-926 MHz bands and narrowband LMS systems at 902-904, 912-918 and 926-928 MHz. The Commission believes that wideband systems

are capable of operating in a shared environment, but asked if there is a need to provide spectrum exclusively for some period of time.

Meanwhile, Congress plans to auction off frequencies for PCN/PCS and other "wireless" uses to raise \$7.5 billion for the U.S. treasury.

Both the House and Senate are acting on several bills relating to Senator Inouye's original "Emerging Technology Initiative" bill, first proposed in 1988. They want the FCC to be able to auction off our precious RF spectrum to the highest bidder, to raise money to help staff the FCC, and to support the ever-growing deficit spending bad habit that Congress and the Democratic administration will just not give up.

It seems that it's too late to plug the leak of integrity and lack of common sense in the dam of government administration. 1984 has come and gone, they are selling our frequencies to the telephone company monopolies and foreign investors — and now they want to spy on us continually, as well!

DATA PRIVACY AND COMMUNICATIONS IN THE USA

Are we repeating the U.S.' predilection to secrecy, privacy and clandestine politics? Are we stuck in a 50 year old rut of paranoia about secret codes and ciphers? Are we confusing the rights of free speech and freedom of communication with the government's need to eavesdrop on suspected criminals? Do we really need to confuse national security issues with business and the individuals rights to use computer encryption?

Since before World War II, the United States has had a great deal of difficulty with the questions asked above. We are a society used to a great deal of freedom in most areas, save one: NSA has always had the right, prerogative and charter to be "The Nation's Codebreaker." The public cannot arbitrarily use secret codes, ciphers or other means of electronic privacy for any purpose! I do not deny the strategic wisdom of such a policy in wartime, as happened during World War II. Now that the Cold War has drawn to an end, I do think we should re-examine the issue and governments' policies in the area, and clarify when the public can use any form of private communications.

The strategic use of codes and ciphers for State secrets and military matters has always been the province of the State — I do not deny that this is necessary! I do feel, however, that when I want to send a private, proprietary message to a business associate that I should be able to deny access to this message to anyone but the Almighty!

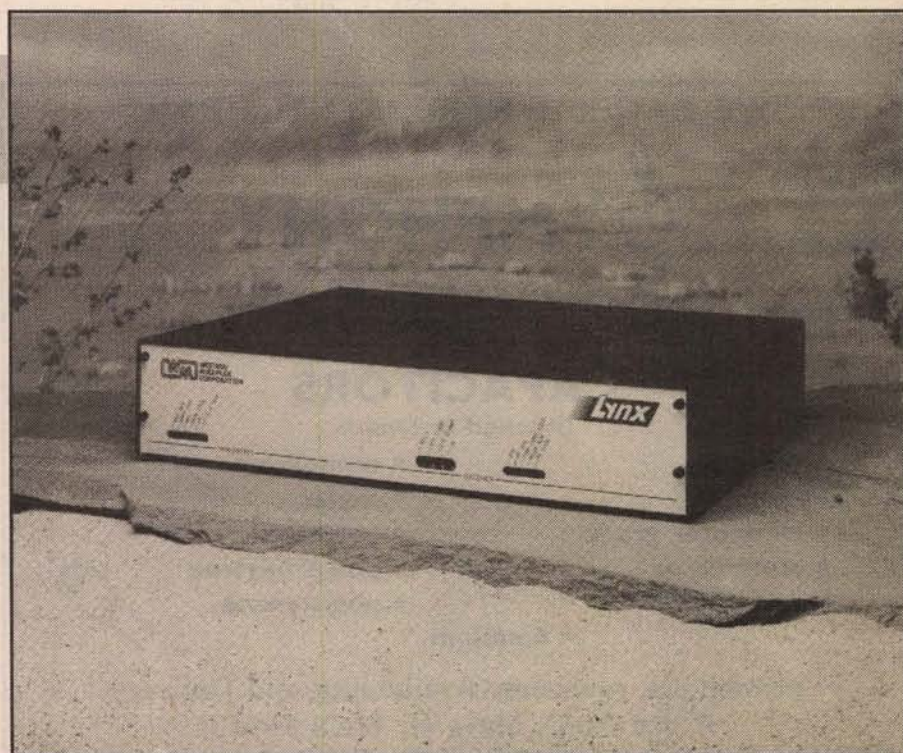
Am I wrong in wanting some of my business or personal communications to be secret? Must I break the law to ensure the privacy of communications guaranteed me in the Constitution and the Bill of Rights?

If the President, the FBI, the NSA and several other government agencies have their way, **anyone will be presumed guilty** if they use a secret code that is not NSA blessed. Further, the government would have us deposit the Legal code's key(s) in an "Escrow Account" that is readily available to any Law Enforcement Agency. I still remember the near police state of the early fifties caused by the likes of the nations top law enforcement officials such as J. Edgar Hoover.

FIGURE 1

Spread Spectrum T1 Digital Microwave Radio

- No license required
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Have you read about NSA's "Clipper computer crypto chip" in the daily papers? Or about what the latest government initiatives on computer cryptography are, and giving the FBI easy access to "Clipper's" keys? The proposed legislation applies equally to wired (via the PSTN) or "Wireless" communication. The insult of having to use the foreshortened DES encryption standard is still being felt by anyone who really understands what it takes to break a code today. Any computer hacker with \$1500 can purchase a 486DX-66 which has the same computing power as any one of NSA's supercomputers of the early 70's. Thus, computer hackers can achieve significant levels of crypto sophistication very easily and inexpensively.

Why do you think so much work has been done at universities, private research labs in Redwood City, CA and elsewhere (Israel, for instance) in support of the privacy of computer communication? Public Key Crypto systems, and similar technological breakthroughs, have provided alternatives to the NSA authorized DES at a time when business and the public most need it.

Life is complicated enough without the average, law-abiding citizen being wiretapped by whatever government agency on some judicial whim or misguided suspicion. Do we need the hassle? I guess we can solve the unemployment problem though: We can all hire secret messengers (couriers) to hand deliver our secret (or proprietary business) messages.

I'll bet the Fortune 1000 alone could hire 40,000 or more such couriers for their needs. The budding entrepreneurs out there can even supply courier services — maybe we'll pull the whole country out of our current economic malaise!

Seriously, who is kidding who with this issue? The whole U.S. population has not turned into couch potatoes, yet! It makes me wonder if the whole U.S. government is out to lunch. Or maybe they just don't understand the issues here!

Government needs must be balanced against the public's needs in a Democratic society. In time of war, some of our freedoms are naturally surrendered for the survival of the State. But in times of "Peace" we want those freedoms back — don't we?

THE LYNX FROM WESTERN MULTIPLEX

Figure 1 highlights some of the salient features of and shows a picture of the SS T1 LYNX from Western Multiplex. Compact, economical and user-friendly, the LYNX radio is designed to be very easy to install and operate. Since no transmitter license is required, a point-to-point LYNX Radio link can be quickly installed without time-consuming and expensive frequency coordination. The 1 Watt transmitter coupled with a sensitive (-90 dBm) receiver allows the LYNX to transport a full T1 digital signal transparently with a digital interface that meets all applicable DSX-1 standards.

I have not tried out a LYNX myself, however, I personally know one of the engineers who helped develop the radio and have followed the development of the LYNX through him.

New SS Hardware from ALPS ELECTRIC

The RadioPort/Parallel is a new SS unit from ALPS Electric. While the unit looks like, and is specified very similar to a Proxim RangeLAN, it has some very interesting features. First, the RadioPort/Parallel interfaces to a PC (or clone) through a standard parallel printer port. Second, the unit is essentially

"Plug and Play" with built-in MS DOS, MS Windows, Artisoft LANtastic and Novell Netware 2.x, 3.x or Lite compatibility. Finally, the RadioPort/Parallel uses an on-the-air data rate of 242 kbps and can communicate up to 800 feet indoors. Take a look at it — it may be just the inexpensive Wireless networking solution you need.

THE FUTURE OF SS HARDWARE IN THE USA

I think the 915 MHz band is dead in the U.S.! If the FCC indeed licenses AVM services throughout the band, there is nowhere a part 15.247 SS or narrowband part 15.249 radio can operate in a large U.S. city without extremely strong interference being present. Even SS systems have a threshold of interference protection! 5 to 500 Watt transmitters, in-band, will most likely kill all useful SS networks at 915 MHz.

The next higher ISM frequency band, 2.400 to 2.4835 GHz, is the next commercial target for SS exploitation. The LYNX, described above, operates at this new, higher frequency band. I know of several manufacturers who are about to announce 2.4 GHz products. Europe (and ETSI standards) have beaten the USA again in this area. The European Community (EC) made 2.4 GHz the standard Wireless Networking frequency band some time ago.

The new band has almost three times the bandwidth of the 915 MHz, and only one major source of jamming: MICROWAVE OVENS. While they are not supposed to leak, I have measured microwave oven emissions as high as -15 dBm, into a quarter wave vertical antenna, at a 20 meter range!

So DAK and many other liquidators may soon be selling bargain basement priced SS equipment for 915 MHz — a great chance for the experimenter to try out SS technology. The rest of the commercial world will almost surely migrate to the ever higher frequency ranges of 2.4, 5.8 and perhaps even 24 GHz.

PARTING NOTES FROM SPREAD SPECTRUM SPOTLIGHT

This is our last column in Nuts & Volts. I've enjoyed doing it every month and I've gotten a lot of encouraging feedback from you wonderful readers out there. However, we at RF/SS have just gotten so busy doing hardware, software and system development for various SS clients that we simply do not have the time to do this column every month. So for now, thank you and good bye!

You may find more information on wireless communications, SS and mobile computing in the pages of **Spread Spectrum Scene** or Andrew Seybold's **OUTLOOK ON MOBILE COMPUTING**, Pinecrest Press, Inc., P.O. Box 917, Brookdale, CA 95007; tel.: (408) 338-7701.

Randy Roberts has over 28 years experience in communications, electronics and Spread Spectrum. His company, RF/Spread Spectrum, is involved in independent consulting, product development, strategic planning, training and publishing. He also publishes "Spread Spectrum Scene," a monthly news magazine. You can reach Randy at P.O. Box 2199, El Granada, CA 94018-2199. His phone is 415-726-6849 and his FAX number is 415-726-0118.

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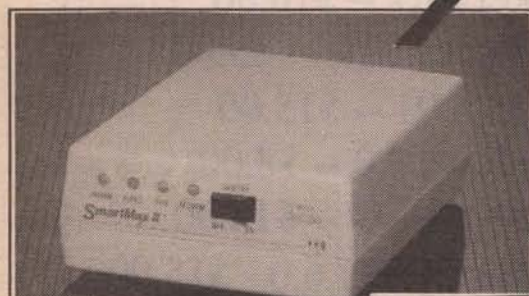
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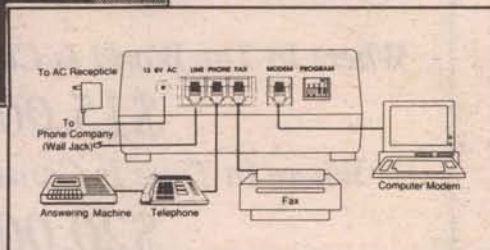
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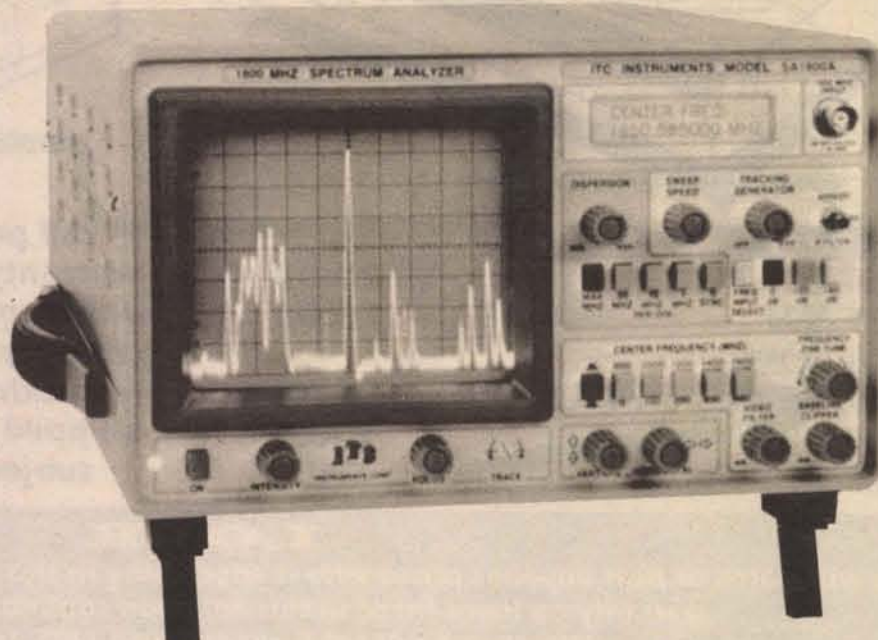
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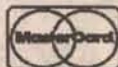
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							FINE FREQ. TUNE	BASE-LINE CLIPPER	VERT. HORZ. CONTR.	SWEEP SPEED CONTR.	
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ITC	SA1000A	\$1595.00	2 - 1000 MHZ	80 dB	-110 dBm	100 HZ*	YES	YES	YES	YES	500 MHZ **
ITC	SA1800A	\$1895.00	2 - 1800 MHZ	80 dB	-110 DBM	100 HZ*	YES	YES	YES	YES	500 MHZ **
B&K	2610	\$2895.00	1 - 1000 MHZ	70 dB	-92 dBm	1 MHZ	NO	NO	NO	NO	2 MHZ
PROTECK	P-7802	\$3500.00	1 - 1000 MHZ	70 dB	-92 dBm	1 MHZ	NO	NO	NO	NO	2 MHZ
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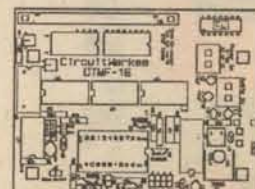
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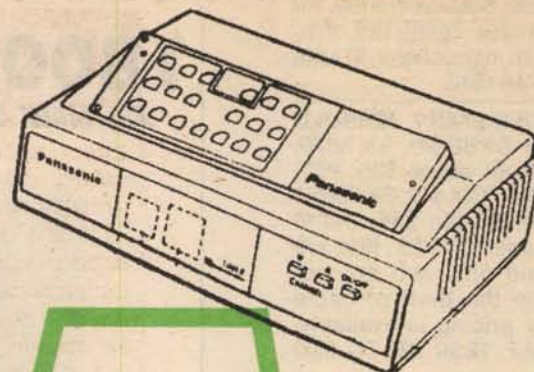
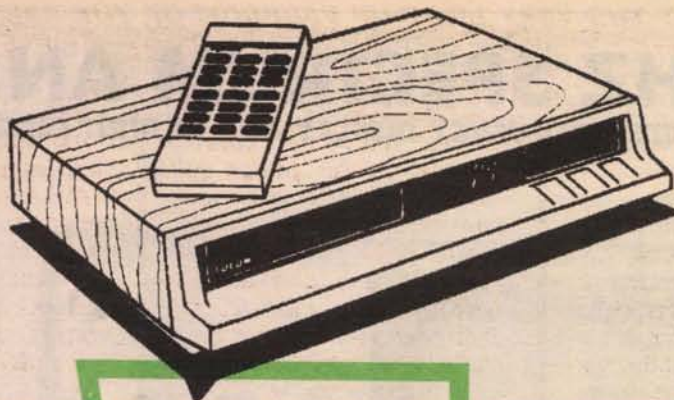
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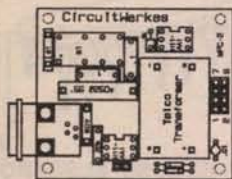
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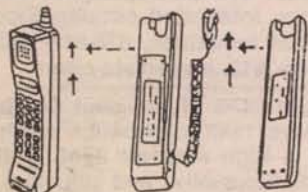
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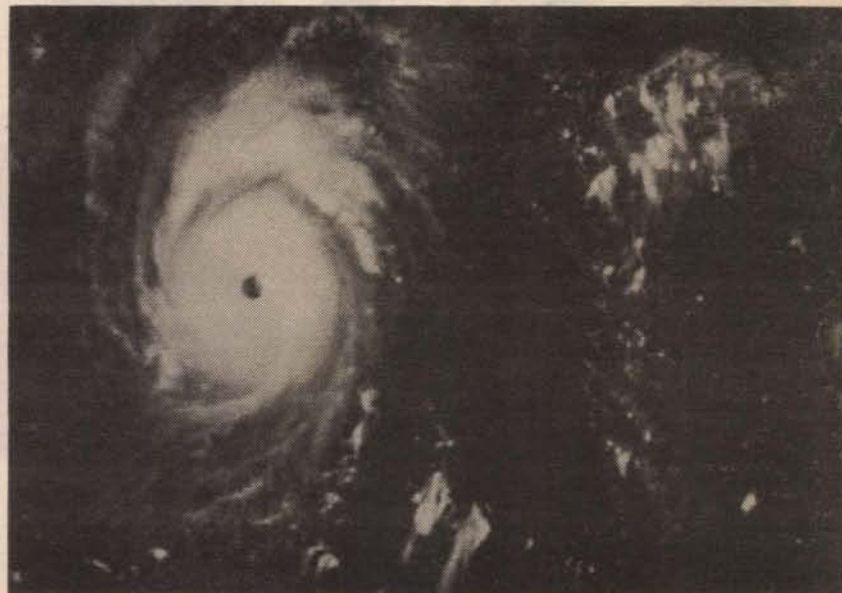
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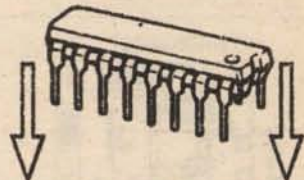
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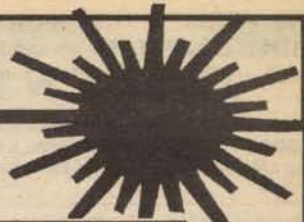
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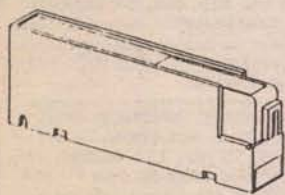
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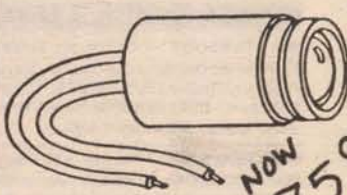
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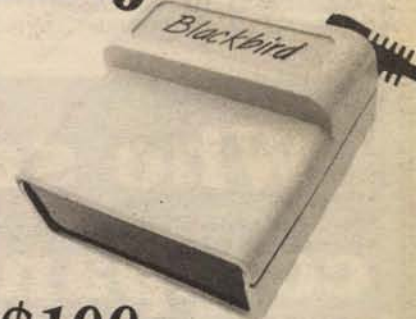
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SALE. LOCATION: Eastern States Exposition. **HOURS:** 10am-4pm. **ADMISSION:** \$7, under 10 free. **FEATURES:** C. **CONTACT:** PC Fest Computer Shows.*

NJ - HACKENSACK — North Jersey Computer Show. **LOCATION:** Fairleigh Dickinson University, Rothman Athletic Center, Rt. 4 to Hackensack Ave S, left at 1st light. **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 500 tables. **CONTACT:** KGP Computer Show*

VT - CHARLOTTE — BARC 41st International Hamfest '93. **SPONSOR:** Burlington Amateur Radio Club. **LOCATION:** The Old Lantern Campground, Greenbush Rd. **ADMISSION:** \$5, over 65 years \$4, under 12 free. **TALK-IN:** 146.61/01, 146.94/34 146.52. **FEATURES:** CB - EX - F - FM - FP - F/R - T. **DEALER INFO:** Tables \$15 adv., \$20 door. **CONTACT:** David Berteau, 802-893-7660.

AUGUST 14-15

AL - HUNTSVILLE — 1993 Huntsville Hamfest/ARRL National Convention. **LOCATION:** Von Braun Civic Center. **HOURS:** Sat. 9am-5pm, Sun. 9am-2. **ADMISSION:** \$5 both days, under 12 free. **TALK-IN:** 146.34/94. **FEATURES:** AC - B - DP - F - FM. **CONTACT:** 205-534-7175 or Huntsville Hamfest, POB 12534, Huntsville AL 35815.

CT - VERNON — 19th Eastern VHF/UHF Conference. **SPONSOR:** Eastern VHF/UHF Society. **LOCATION:** Quality Inn. **CONTACT:** Eastern VHF/UHF Society, 458 Allentown Rd., Bristol CT 06010.

PA - READING — PC Dealer Showcase. **SPONSOR:** Star Ware. **LOCATION:** Berkshire Mall. **HOURS:** Sat. 10am-9:30pm, Sun. Noon-5pm. **ADMISSION:** Free. **FEATURES:** AC - FP - F/R. **CONTACT:** Star Ware 800-523-0702.

AUGUST 15

MA - BOXBOROUGH — PC Fest Computer Show & Sale. **LOCATION:** Boxborough Host Hotel. **HOURS:** 10am-4pm. **ADMISSION:** \$7, under 10 free. **FEATURES:** C. **CONTACT:** PC Fest Computer Shows.*

MA - CAMBRIDGE — Tailgate Electronics, Computer and Amateur Radio Flea Market. **SPONSOR:** MIT Electronics Research Society, the MIT Radio Society and the Harvard Wireless Club. **LOCATION:** Albany and Main St. **HOURS:** 9am-2pm, rain or shine. **ADMISSION:** \$2. **TALK-IN:** 146.52, 449.725/444.725 - PL 2A. **FEATURES:** C - E - H.

DEALER INFO: Room for 400 sellers. \$5 adv (before the 5th), \$8 gate (includes 1 admission). 7am setup. **CONTACT:** WIGSL, PO Box 82 MIT BR., Cambridge MA 02139; 617-253-3776.

NH - BEDFORD — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Sheraton Wayfarer. **HOURS:** 10am-3:30pm. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Mark Zolla, 508-744-8440.

PA - EASTON — Hamfest & Computers. **SPONSOR:** Delaware-Lehigh Amateur Radio Club, Inc. **LOCATION:** Career Institute of Technology. **HOURS:** 8am-7. **ADMISSION:** \$3 adv., \$4 door. Spouse free. **TALK-IN:** 146.70. **FEATURES:** EX - F - F/R - T. **DEALER INFO:** Inside vendors \$15, tailgaters \$6 adv., \$7 door (incl. admission). **CONTACT:** Bill Goodman K3ANS, 215-253-2745 (office), 215-258-5063 (home), or DLARC 215-820-9110.

AUGUST 21

NY - ITHACA — Finger Lakes Hamfest & Computerfest. **SPONSOR:** Tompkins County ARC. **LOCATION:** New York State Armory, Rte. 13 & Hanshaw Rd. **HOURS:** 7am-3pm. **ADMISSION:** \$4 adv., \$5 door, under 18 free. **TALK-IN:** 146.37/97. **FEATURES:** DP - EX - FM - F/R. **DEALER INFO:** Indoor table provided \$7 ea., outside paved flea market space \$2 per 6'. Setup Fri. eve and 6am Sat. **CONTACT:** TCARC, POB 4144, Ithaca NY 14852-4144. Ross N2ISU, 607-257-3511.

PA - FORT WASHINGTON — Fort Washington Computer Show. **LOCATION:** Fort Washington Expo Center, PA Tpke Exit #26. **HOURS:** 10am-3pm. **FEATURES:** C. **DEALER INFO:** 1000 tables. **CONTACT:** KGP Computer Shows*.

VA - NORFOLK — Norfolk Computer Fair & Sale. **LOCATION:** Scope Convention Center. **HOURS:** 10am-3pm. **ADMISSION:** \$4. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Tri-State Fairs*.

VA - TYSONS CORNER — CMA Computer Show. **LOCATION:** Westpark Hotel, Leesburg Pike (DC Capital Beltway). **HOURS:** 9:30am-3pm. **ADMISSION:** \$5, under 12 free. **FEATURES:** C. **DEALER INFO:** 6-ft table \$60 incl electricity. 7:30am setup. **CONTACT:** CMA Shows, 804-272-1570.

AUGUST 21-22

PA - KING OF PRUSSIA — Valley Forge Hamshows

1993. **SPONSOR:** Hamshows. **LOCATION:** Valley Forge Convention Center. **FEATURES:** C - CB - DP - EX - FM - FP - H - S. **CONTACT:** Hamshows, POB 3865, Shawnee KS 66203. 913-422-4646, FAX 913-422-4648.

AUGUST 22

MA - PEABODY — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Peabody Holiday Inn. **HOURS:** 10am-3:30pm. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Mark Zolla, 508-744-8440.

MD - TOWSON — Moose ARC Ham & Computerfest. **SPONSOR:** Moose Amateur Radio Club. **LOCATION:** Loyol Order of Moose, Towson Lodge 562. **HOURS:** 8am-4pm. **ADMISSION:** \$4, under 12 free. **TALK-IN:** 145.330, 224.12. **FEATURES:** F/R - T. **DEALER INFO:** Tables \$10 plus admission. Tailgating \$5 plus admission. **CONTACT:** Nick Nickles WZ3J, 410-668-2363 or Loyol Order of Moose, Towson Lodge 562 Moosefest, 8801 Mylander Ln., Towson MD 21286.

AUGUST 28

FL - WEST PALM BEACH — Narisaam Computer Show. **SPONSOR:** NARISAAM, Inc. **LOCATION:** Palm Beach Airport Hilton, 150 Australian Ave. **HOURS:** 10am-4pm. **ADMISSION:** \$5, \$4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** NARISAAM.*

NJ - EDISON — New Jersey Computer Show. **LOCATION:** Raritan Center Expo Hall, NJ Turnpike Exit #10 to Rt 514 West. **HOURS:** 10am-3pm. **FEATURES:** C. **DEALER INFO:** 1,200 tables. **CONTACT:** KGP Computer Shows*.

NY - CHAFFEE — Snowbelt Ham & Computer Fest. **SPONSOR:** Arcade Kiwanis. **LOCATION:** Manion Park. **HOURS:** 6am-5pm. **ADMISSION:** \$3 adv., \$4 door. **TALK-IN:** 145.39, 444.175. **FEATURES:** DP - FP - F/R - T. **DEALER INFO:** Free tailgating w/admission. **CONTACT:** Mike Wrona, 139 Greenmeadow Dr., West Seneca NY 14224.

AUGUST 29

FL - FORT LAUDERDALE — Narisaam Computer Show. **SPONSOR:** NARISAAM, Inc. **LOCATION:** Holiday Inn West, 5100 N State Rd 7. **HOURS:** 10am-4pm. **ADMISSION:** \$5, \$4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** NARI-

SAAM*.

NY - YONKERS — Hamfest/Computerfest. **SPONSOR:** Yonkers Amateur Radio Club. **LOCATION:** Yonkers Municipal Parking Garage, Main St. **HOURS:** 9am-3pm. **ADMISSION:** \$5, XYL, YL, under 12 free. **TALK-IN:** 146.865, 440.150. **FEATURES:** C - CB - DP - F/R - H. **DEALER INFO:** Vendors \$10 adv., \$14 door. AC power available w/pre-registration. **CONTACT:** John WB2AUL, 914-963-1021 or Him N2ONM, 914-969-5182.

TN - LEBANON — Hamfest. **SPONSOR:** Short Mountain Repeater Club. **LOCATION:** Cedars of Lebanon State Park, US Hwy 231. **HOURS:** 7am-3pm. **ADMISSION:** Free. **TALK-IN:** 146.91. **FEATURES:** F/R. **CONTACT:** Mary Alice Fanning KA4GSB, 4936 Danby Dr., Nashville TN 37211. 615-832-3215.

SEPTEMBER 4

MD - NEW CARROLLTON — CMA Computer Show. **LOCATION:** Sheraton Hotel Exhibition Center. Exit 20 off I-95 Capt. Bitway. **HOURS:** 9:30am-3pm. **ADMISSION:** \$7, under 12 free. **FEATURES:** C. **DEALER INFO:** Table-Spaces: Wall \$75, other \$60 (6'). 250+ tables. **CONTACT:** CMA Shows, 804-272-1570.

NY - MIDDLETOWN — Orange County Computer Fair & Sale. **LOCATION:** Orange County Fairgrounds Arena, I-84 Exit 4E - Rt 17 Exit 122, Middletown Rd. **HOURS:** 10am-3pm. **ADMISSION:** \$5. **FEATURES:** C. **DEALER INFO:** 150 tables, 2,000 expected attendance. 8am setup. **CONTACT:** Tri-State Fairs*.

SEPTEMBER 4-5

NC - SHELBY — 36th Annual Shelby Hamfest. **LOCATION:** Cleveland County Fairgrounds. **TALK-IN:** 146.28/88. **FEATURES:** DP - FM - FP - RV - H - T. **DEALER INFO:** Barbara Elliott N4MRZ, POB 191, Fallston NC 28042. 704-538-7919. **CONTACT:** John T. Ledford N4GOQ, 3410 Oakcrest Dr, Shelby NC 28150. 704-482-4507.

SEPTEMBER 6

NJ - SECAUCUS — Meadowlands Computer Fair & Sale. **LOCATION:** The Hilton, off Rte. 3 Meadowlands Pkwy. **HOURS:** 9:30am-4:30pm. **ADMISSION:** \$6, \$5 after 1pm. **FEATURES:** C. **DEALER INFO:** Setup 7am. 250 tables. **CONTACT:** Tri-State Fairs*.

Continued on page 115

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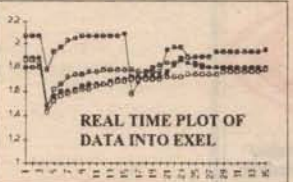
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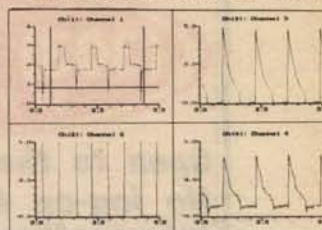
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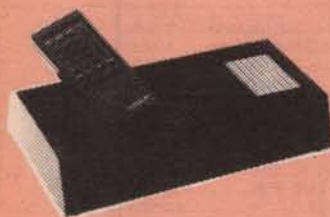


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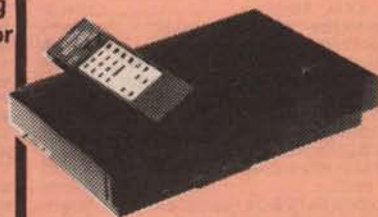
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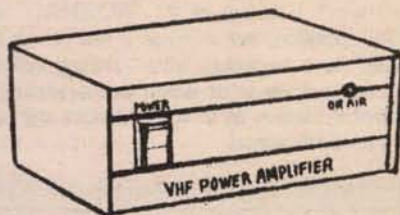
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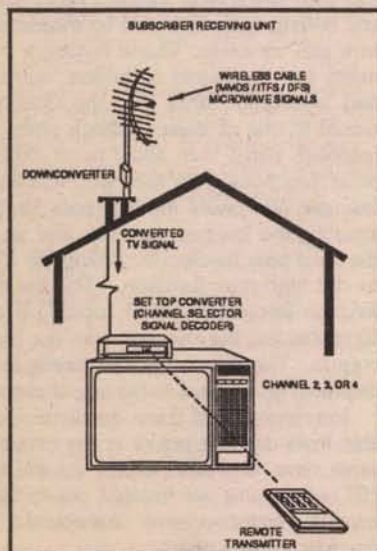
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It does everything – low-pass (LP), high-pass (HP), band-pass (BP), all-pass (AP), band-reject (BR), and even crossover (CO).

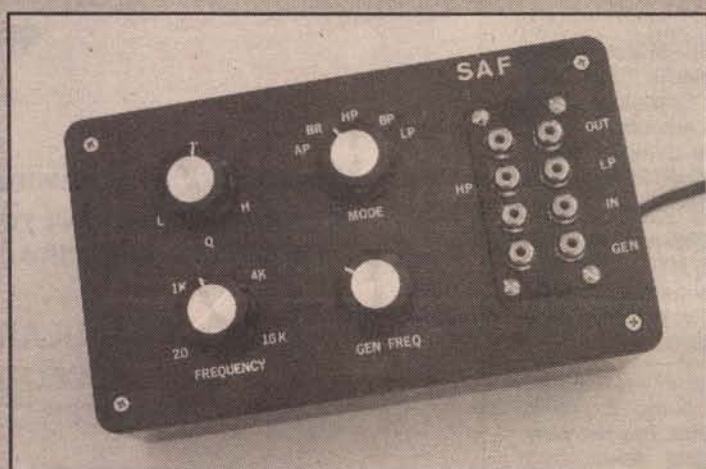
Although designed for education and fun, this filter can also serve as an instrument to test amplifiers and speakers. In its BR mode, it can be permanently installed in a public address sound system for feedback control. In its BP mode it makes a great "dialog" filter to make voices really stand out in old movies or tape recordings. With its simultaneous LP and HP outputs, which are brought out to the front panel, it can be used as an electronic crossover in bi-amplified sound systems.

The center frequencies of the BP and BR modes are always the same as the cut-off frequencies of the LP and HP modes for any one frequency setting.

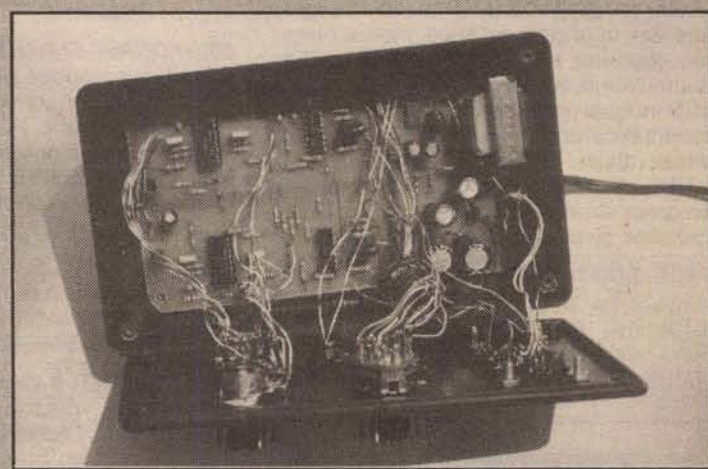
The Q of the filter response in BP mode is adjustable with a single front panel knob. For most work it is set at its "NORMAL" or "LOW" position, but at times it will be set to "HIGH" as is necessary when creating bell or bass drum sounds or when demonstrating damped sinewaves as to sound and/or sight (if using an oscilloscope).

waveform look different, they make it sound vastly different from that of a sinusoid. Because different kinds of musical instruments produce different compliments of these harmonics, (as to amount, amplitude, and phase), the sound produced by them is quite distinct and characteristic. The same principle applies to the human voice.

The Super Audio Filter has the ability to accentuate or attenuate these various harmonics so as to show their importance in our identifying various sounds. The latter part of this



FRONT VIEW



INSIDE VIEW

As an educational tool, it will demonstrate which frequencies are essential for speech or music, and help you better understand the importance of harmonics in the various sounds you hear. You will learn about bandwidth, "Q", cut-off, even and odd harmonics, and more. You will also learn that various electrical wave forms generate distinct, predictable sounds, and that when their harmonic content is altered, so is the sound and waveform altered. Do you know what a damped waveform is, and what it "sounds like?"

As an entertainment device, this filter will produce interesting and even "earth shaking" tones when it is connected to a wide range sound system while using its built-in low frequency squarewave generator. The same is true if a pink noise generator is used as a signal source. That's what I said, PINK NOISE. You didn't know noise comes in colors, did you?

Actually pink noise is a legitimate expression. It refers to random noise that has been modified (by filtering) to exhibit constant power content in any of its octave bands. This modified "white noise" (here we go again), when used in the testing of audio equipment, makes performance analysis much easier than it would be if white noise was used. A pink noise generator is like an audio frequency generator that outputs all frequencies at the same time. It is a very useful type of signal.

Back to the Super Audio Filter. This device is a dual tunable frequency, multiple mode audio filter. Viewed from one of its two channels, it has one input and five modes of output. A rotary switch provides for selection of any one of these modes. In addition to mode selection, the LP and HP outputs are brought out to the front panel for crossover work. One of the five output modes is an all-pass mode for the purpose of making unfiltered and filtered comparisons.

The frequency range of the filter is front panel adjustable from 20 Hz to 16 KHz, accomplished with the turning of one knob.

In regard to Q, it should be noted that this filter exhibits highly desirable constant Q characteristics, sometimes called "constant percentage band-width." This means that the bandwidth percentage (in BP and BR modes) and the slope (in LP and HP modes) remains the same regardless of the frequency setting. This is an important consideration when the unit is being used in audio analysis work.

The filter also features a built-in low frequency (LF) squarewave generator that covers a range of 1 Hz to 150 Hz. Using this as a signal source for the filter, the operator can produce the above mentioned sounds, and in addition prove that squarewaves are actually made up of sinewaves (more on this later). The "waa-waa" sound can also be produced with the use of this LF generator.

The filter is designed for line-level operation which means it will work well in the "external device" loop of your receiver or mixer board. It also works well when connected between a CD player and sound system. Of course there are other places too where line-levels can be found.

Here are a few facts about sound that our filter will prove or at least emphasize:

The various kinds of sound we hear each day whether it be speech, music, or the wind moving through the trees, is very complex in nature. For example, we may like to think that a musical note being played on a piano or violin is a nice smooth sinusoidal shaped waveform (whether one considers its acoustical waveform or its electrical representation). Not so! Though the note has a basic lower frequency form, it is actually made up of a myriad of higher frequency waveforms that are mathematical multiples of the basic note. These higher frequencies, which are called harmonics or overtones, are lower in amplitude and ride on various parts of the waveform. They give the waveform a very jagged distorted look when viewed on an oscilloscope.

Not only do these harmonics make the

article will show how this can be done.

THE CIRCUIT – HOW IT WORKS:

The heart of the circuit is the IC called "dual transconductance operational amplifier" (TCA), (IC1, on schematic). Considering one section only, we can think of it as a current controlled resistor in series with an amplifier. As such, the addition of a capacitor to ground can give us a current controlled LP filter. By feeding the output of this first LP filter to the input of a second identical filter, we can create a two pole, LP filter whose cut-off frequency is controlled by the amount of current flowing from the current control pins of the IC to ground.

This, in fact, is what we have and it is the basis for the five function filter. How are the other functions obtained?

As you refer to the schematic diagram, note that there are several feedback paths from various outputs back to inputs by means of resistors and op-amps. These feedback components are configured as adders, subtractors, and inverters. Note that the Q control is placed in one of these feedback paths. These feedback paths then allow us to extract the other functions from the basic function. For example: We create the high-pass function by inverting the low-pass function, and we create the band-pass function by adding the low-pass to the high-pass function. The band-reject function (sometimes called "notch") is created by subtracting the low-pass from the high-pass outputs. The all-pass function merely feeds the unfiltered input signal to the output circuit.

Interestingly, all these functions are available from different points in the circuit at the same time. However, except for the LP and HP outputs that are brought out to the front panel for crossover work, the operator selects one function at a time.

Frequency control is accomplished by means of the 39K ohm resistor connected

between the current control pins on the TCA and the wiper of the "FREQUENCY" control potentiometer (pot). As the pot has voltage applied across its element (from the negative supply through a diode and a trim pot), it works with the resistor to effectively vary the current through the control pins of the TCA, which in turn varies the frequency. By the way, lower control current produces lower frequency.

The trim pot in this circuit adjusts the voltage across the frequency control pot so that the filter frequency will be 20 Hz when the knob is set at its full counterclockwise (CCW) position.

Note that the input signal first meets an op-amp configured to produce a "gain" of only two tenths. This attenuation is necessary to prevent distortion in the TCA that might otherwise occur if the signal levels were greater. The output stage, however, produces enough gain to restore the input signal to a useable output level regardless of the selected mode.

The variable LF squarewave generator is made up of an op-amp, a capacitor, and a few resistors. Both op-amp inputs receive feedback signals from the op-amp output through resistors, one of these being the frequency control itself. As one of these feedback paths is positive, meaning that it reinforces its own output, the result is a free-running oscillator that produces a squarewave output.

The DC power supply is made up of a 12 volt transformer, with diodes and capacitors configured to produce both positive and negative voltages. The voltages produced across the input filter capacitors feed zener diodes through current limiting resistors, to ultimately provide a regulated positive and negative 12 volts for all of the circuitry. The large capacitors across the zener diodes accomplish a degree of ripple filtering and zener noise reduction.

CONSTRUCTION AND TESTING:

Begin by building the printed circuit board (PCB). Refer to the parts layout diagram and install the various components a few at a time, of course soldering the component leads and clipping off the excess wire. Keep in mind that the diagram shows the component side of the board, not the copper side. Be sure to install the polarized components properly as to orientation as indicated by +, -, or other markings for this purpose. If you are going to use the perf board method of construction, it is recommended that you still follow the same general layout as indicated on the parts layout diagram. After the board has been built and checked for proper parts placement and solder connections, you are ready to test it.

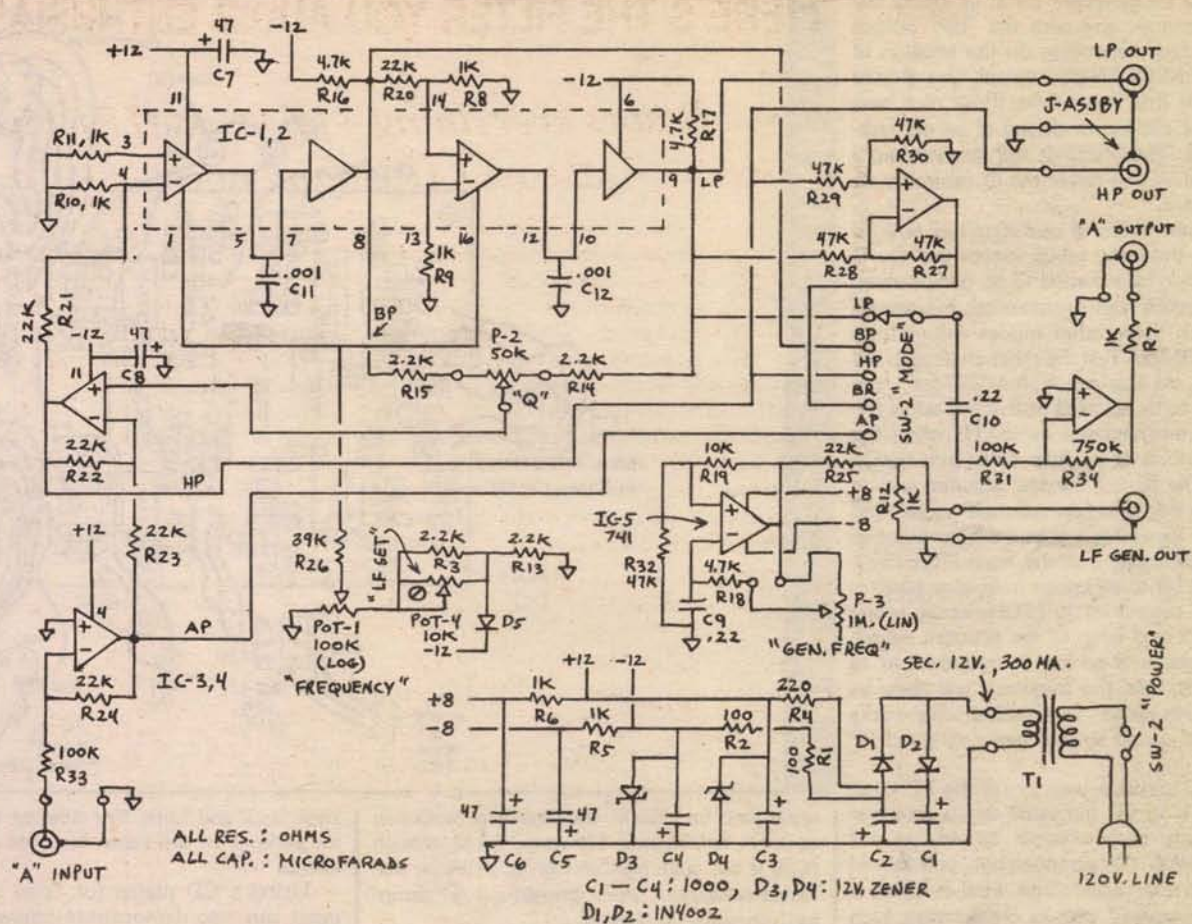
For this procedure I recommend that you strip and tin all the wires needed to connect the external parts such as the pots, switches, input and output jacks, etc., to the board. These wires should be around 6" in length and can be stranded or solid, #22 size. Connect these wires and parts to the board and spread it all out on the bench.

Before applying power, set all trim pots and panel pots to their mid range. Also, it might be well to have handy your meter and perhaps an oscilloscope. It would be wise not to connect the unit to your audio system until you are sure it is working properly.

Apply power and make a quick check of the negative and positive 12 volt points on the board with the meter. Also check the voltage at all the op-amp output points. These can be located at the corner pins of the integrated circuits #LM 348 or #4741. The voltages should measure zero or very close to it. The LF generator output can be tested with an oscilloscope, but if one is not available, it can be tested with your meter set to read DC VOLTS. In this case, the generator frequency should be set to its 1 Hz position, and if your meter "jumps around," the LF generator is likely working OK.

If the unit passes these tests successfully, connect the LF generator output to one of the filter inputs, and connect the corresponding filter output to your audio system.

SUPER AUDIO FILTER SCHEMATIC



PARTS LIST

RESISTORS:

(all 1/2 watt, 5% tol., carbon or metal film, unless otherwise noted)

- R1,R2: 100 ohm (total 2)
- R4: 220 ohm (total 1)
- R5a/b through R12a/b: 1K ohm (total 16)
- R3a/b,R13a/b,R14a/b,R15a/b: 2.2K ohm (total 8)
- R16a/b,R17a/b,R18a/b: 4.7K ohm (total 6)
- R19a/b: 10K ohm (total 2)
- R20a/b through R25a/b: 22K ohm (total 12)
- R26a/b: 39K ohm (total 2)
- R27a/b,R28a/b,R29a/b,R30a/b,R32a/b: 47K ohm (total 10)
- R31a/b,R33a/b: 100K ohm (total 4)
- R34a/b: 750K ohm (total 2)

CAPACITORS:

- C1,C2,C3,C4: 1000 microfarad, 35 volt, electrolytic, PCB mount, Radio Shack #272-1032
- C5,C6,C7,C8: 47 microfarad, 25 volt, electrolytic, PCB mount
- C9a/b,C10a/b: 22 microfarad, 50 volt, 10% tol., PCB mount, Radio Shack #272-1070 (total 4)
- C11a/b,C12a/b: .001 microfarad, 50 volt, 2.5% tol. preferred, (10% tol. may work)

DIODES:

- D1,D2: 1N4002 (note: suffix nos. 3-7 also OK)
- D3,D4: 1N4742, zener, 12 volt, 1 watt, Radio Shack #276-563
- D5a/b: 1N4148 (total 2)

POTENTIOMETERS (Pots)

- POT-1: 100K ohm, dual, audio taper, panel mount, Radio Shack #271-1732b
- POT-2: 50K ohm, dual, linear taper, panel mount, (note: if can't find, use two singles, modify panel, Radio Shack #271-1716)
- POT-3: 1 meg.ohm, linear taper, panel mount, Radio Shack #271-211
- POT-4a/b: 10K ohm, min. trim type, Radio Shack #271-282 (total 2)

INTEGRATED CIRCUITS (ICs):

- IC-1,IC-2: National #13600 or ECG/Phillips #870
- IC-3,IC-4: #LM 348 or NEC #4741C (equiv. OK)
- IC-5: #741

SOCKETS: SKT1,SKT2: 8 DIP, solder tab (for IC1 and IC2, TCAs)

SWITCHES:

- SW-1: 2 pole, 6 position, rotary, Radio Shack #275-1386
- SW-2: S.P.S.T., toggle (optional)

TRANSFORMER:

- T1: 12.6 volt secondary, 300 ma., Radio Shack #273-1385b

INPUT/OUTPUT JACK ASSEMBLY:

- J-ASSBY: 8 phono jacks, Radio Shack #274-370

CASE/ENCLOSURE:

- 7 1/2" x 4 1/4" x 2 1/4", Radio Shack #270-224

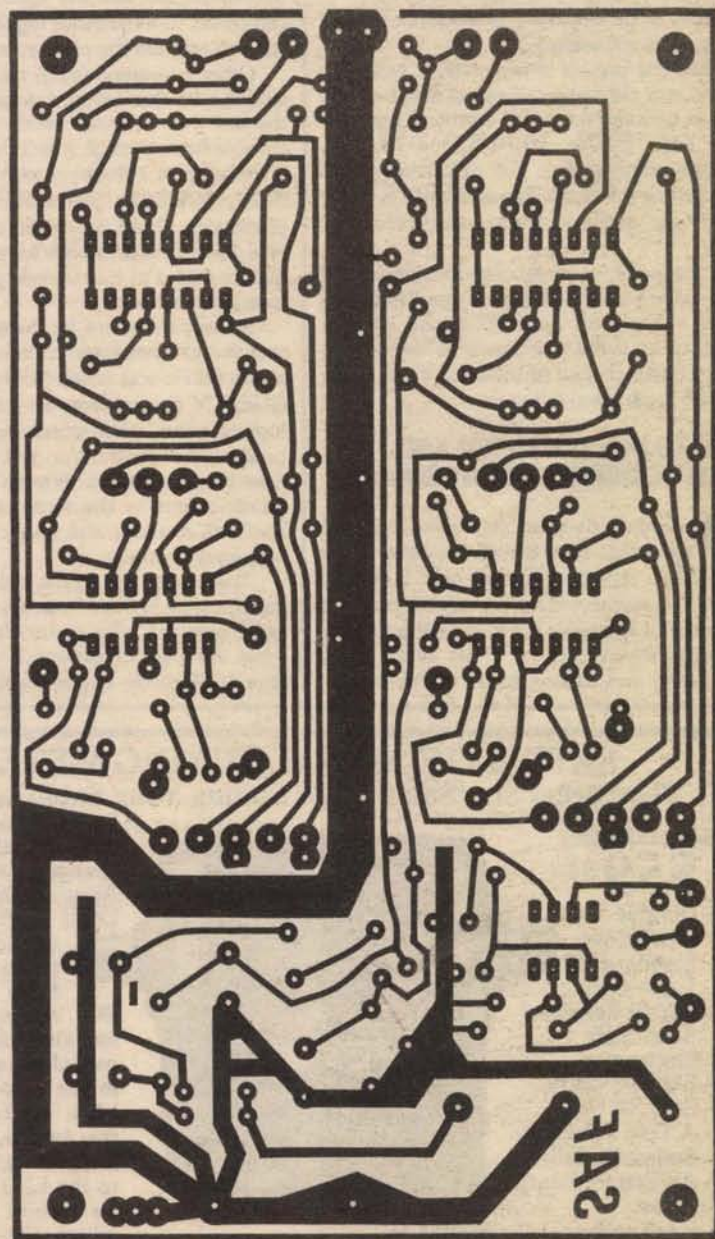
MISC.:

- Line cord, knobs, rub on lettering, 6/32 nuts and bolts, etc.

PRINTED CIRCUIT BOARD:

- Part # "SAF". Note: this part is available from Richard Schroeder, P.O. Box 363, Walnut, CA 91789, board only, drilled, not plated, cost: \$8.50; Calif. res. add 8.25%.

PRINTED CIRCUIT BOARD



With the LF generator set at its lowest frequency position, and with the "BP" output mode selected, depending on the rotation of the main FREQUENCY control, you should hear sounds that range from those of a bass drum to the clicking or ticking of an old fashioned clock. These sounds will be even more pronounced as you rotate the Q control to its HIGH position.

The other modes of operation can now be tested with the same set-up except that the Q control should be returned to its mid-position. Though possibly less pronounced, the sounds produced in these other modes will confirm proper operation. Test the other channel in the same way. At this point, the "LF set" trim pot(s) need to be adjusted so that the actual frequency of the filter will be 20 Hz when the control knob is at its fully counterclockwise position. The easiest but less accurate way to accomplish this is to first select BP mode, and use the LF generator (set to 1 Hz) as input to the filter. Secondly, with the main FREQUENCY control set to its lowest frequency position and the Q control set to HIGH, slowly rotate the trim pot and listen to the resultant sound. As the sound gets so low in frequency as to become inaudible, the frequency will likely be in the 20 Hz range. This method only works well if your sound system has very good LF response.

A more accurate way to set the LF knob calibration is to use the same set-up as above but use an oscilloscope as an output indicator. With this arrangement, you should observe on the oscilloscope what is called a "damped sinewave" with its characteristic high amplitude first cycle and exponentially diminishing subsequent cycles. Using the time base system of the scope, adjust the trim pot(s) to display the proper number of cycles on the screen. Calibration of the FREQUENCY control knob at its clockwise position or highest frequency, is automatic.

When the project is complete, it would be good to also put some calibration marks on the panel in between the "end" points at say, 200 Hz, 1 KHz, 5 KHz, 10 KHz, and 16 KHz. The general procedure just described should aid in getting this done. Panel lettering is of the rub-on type, available at most electronic parts stores.

At this point, you may wish to use your CD player, tape player or tuner as input to the filter as this too will confirm proper operation, or if the unit seems to be working OK, you may choose to mount it in an enclosure and begin using it that way.

WAYS TO USE THE FILTER AND A FEW COMMENTS ABOUT SOUND:

Regarding damped sinewaves, keep in mind that even though the squarewave may have a repetition rate of only 1 Hz, the damped sinewaves will have a repetition rate or frequency of whatever the filter's BP frequency happens to be set to. This is because the leading and trailing edges of the square-

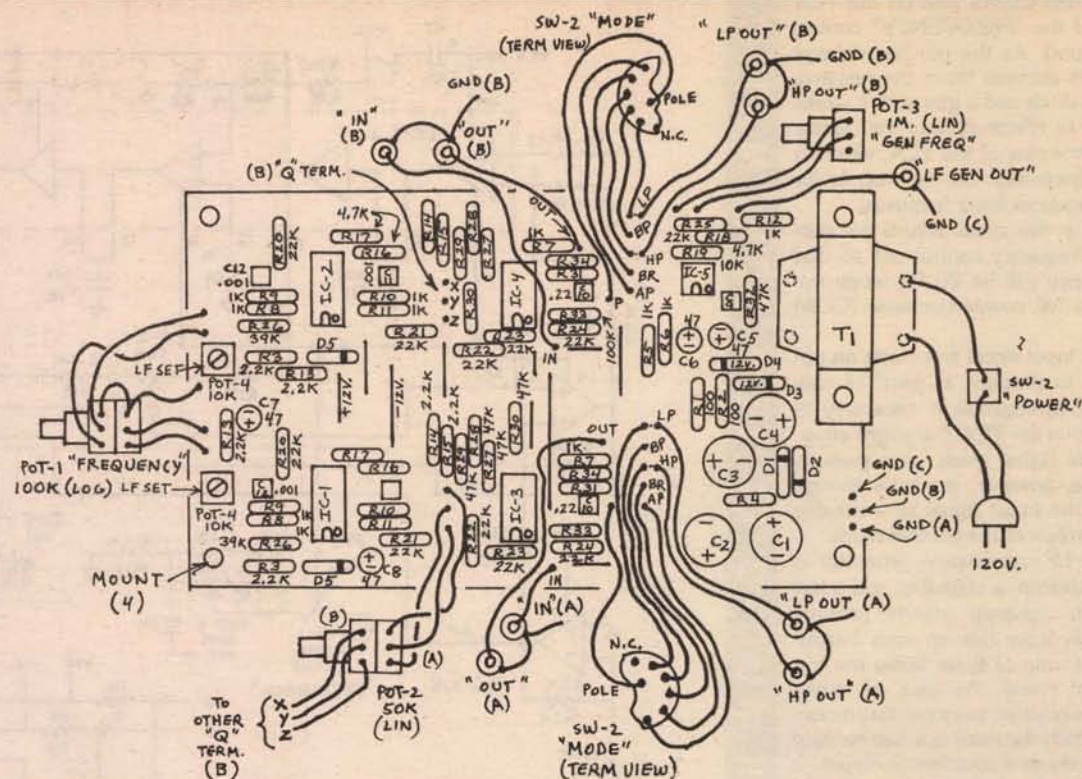
wave tend to "shock" the filter into oscillation as it has very high Q. However, the Q, though high, is not quite high enough to maintain sustained oscillation, hence diminishing or "damping" sinewave oscillations.

Demonstrating damped sinewaves, can be effectively done by using the squarewave generator as input to the filter, and a wide range sound system and oscilloscope as output. Remember too that the squarewave generator can be set to frequencies higher than 1 Hz and still demonstrate the phenomenon.

Other interesting things can also be demonstrated with this set-up. For example, showing the fact that electrical waveforms contain predictable harmonics. It is fact that a squarewave is made up of a sinewave with only its odd harmonics added in phase and in diminishing amplitudes. Other waveforms are also made up of a basic sinewave with its even or odd harmonics added to it in various phase and amplitude configurations.

Some of this can be demonstrated by setting the LF generator to most any frequency above 50 Hz and slowly turning the main FREQUENCY control from its lowest point to its highest point, while observing the sound and oscilloscope display. You will note that as the filter frequency slides through the various harmonic points of the squarewave, the sound level will increase and the scope will show a high level sinewave.

This set-up also works well for demonstrating the well known "waa-waa" sound that is quite popular with guitarists. Show this by again using the LF generator as input, with the filter in BP mode, and rotate the FREQUENCY



knob back and forth. Try different LF generator settings at the same time for interesting effects.

Using a CD player (or other source) as input can also demonstrate interesting facts about sound and harmonics. While listening to music, switch to different modes and Q settings. Note that in BP mode, you can almost tune in a particular instrument while tuning out all the others, or you can greatly exaggerate the bass or the cymbals. Note too that instruments lose much of their characteristic sound when certain frequencies are cut off or "notched" out. Much can be learned by simply turning the knobs.

If you have access to a pink-noise generator, try using this as an input source. This in conjunction with the filter can also demonstrate some interesting aspects of sound. This set-up can produce sounds like wind, surf, or distant thunder. There are even ways to use this set-up for spectrum analysis and sound system equalization. Plans for building a professional type pink-noise generator should be forthcoming soon in a future issue of Nuts and Volts.

As mentioned in various places in this article, there are many ways that this filter can be used - some for fun, some for education, and some for serious work. You may wish to try some or all of these. **NV**

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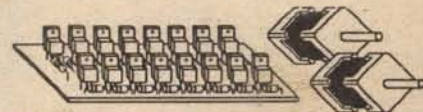
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ELECTRONIC PRIVACY PART 2

Surveillance Devices and Countersurveillance Methods

We presented an introduction to the complex, shadowy world of intercepting phone calls and private conversations in the last issue of Nuts & Volts. Today we'll take a look at the type of equipment that is (or can be) commonly used for this purpose – both by professionals and amateur snoops. Even more importantly, we'll give you an inside look at countermeasures. From simple steps to help increase your information security, to locating a competent countermeasures expert...often a difficult task.

Certain highly competitive big-bucks businesses are especially vulnerable targets for electronic surveillance. This type of industrial espionage

is most likely to occur in firms involved in union negotiations, acquisitions, mergers, new product development, etc. Being the best in your field can also lead to tapped phones or hidden microphones. When you're on top, there is always someone looking to knock you out of that position.

Law enforcement agencies also use sophisticated electronic equipment during surveillance. If conducted pursuant to a court order, this is fine. Our objective with this article is not to assist anyone involved in criminal activity to escape police scrutiny, but we will examine some techniques used by these professionals.

GLADYS KRAVITZ GOES HIGH-TECH

Gladys who? I'll never forget the character in the television show "Bewitched" named Gladys Kravitz. Watching the show as a child, Gladys became the prototypical nosey neighbor: always peeking through curtains, spying on the other residents of her street. That's all this lady did. The character is almost an archetype.

If Gladys had been able to avail herself of modern technology, her living room would look like the control center at some elaborate lab. If she had a multi-billion dollar-a-year classified budget, she'd be the director of the U.S. government's National Security Agency (NSA), snooping on the whole country – not just her street.

Other than humor, I use Gladys to make a very important point: The majority of electronic eavesdropping is conducted by John or Jane Q. Citizen. The target of this surveillance is usually a spouse or 'significant other.' With the ready availability of low-cost devices that can be used to record phone calls or conversations in a specific room, it's not surprising that suspicious husbands or girlfriends use such "bugging" equipment to keep tabs on each other. I guess trust is just too old-fashioned for the 90's.

LAW ENFORCEMENT STATISTICS

There are some of you who are no doubt surprised to learn that the majority of all electronic surveillance is not conducted by law enforcement agencies. Check out the *real* surprise at the end of the following statement made by B. T. Bohard in *Full Disclosure*:

"When one adds the number of an average year's court orders for electronic surveillance (I mean every wiretap, bug, cellular phone intercept, and every local, county, state, federal and intelligence warrant issued by a court), the grand total comes to under 2,000 authorizations per year."

It is rather difficult to believe that with less than 2,000 court-ordered intercepts taking place each year, hundreds of law enforcement surveillance suppliers are kept in business by selling interception

equipment. With all the equipment that has been purchased by various alphabet soup agencies and smaller police departments, one would assume over 200,000 intercepts were being conducted annually in the United States.

But remember – the figure of less than 2,000 cited above are court ordered intercepts. Do you believe the interception equipment sold for millions each year is simply being added to a pile of previously purchased equipment stored away, gathering dust? History repeats itself endlessly, and people like J. Edgar Hoover and Richard Nixon just happened to have the misfortune of being caught...but draw your own conclusions, please.

It's like the NSA's interception facility near an AT&T communications tower in Maryland. Just because the NSA has equipment in place to monitor domestic telephone traffic within the United States doesn't mean they do, correct?

As obedient citizens, I think we are obligated to turn our heads when we become aware of Hooverian abuses of power. Doesn't the end justify the means when it comes to catching criminals? So what if your phone line is tapped and your conversations monitored for a month by the FBI as they clandestinely seek to determine who in your neighborhood may be involved with organized crime.

I can almost feel pity for agents of many alphabet-soup agencies since they no longer have "communism" to hold up as a rationale for their McCarthyism. To quote Bohard, "...communism has gone the way of cheap gasoline and quill pens – historically interesting but irrelevant dinosaurs."

Despite the appearance, my dry sarcasm is not intended to grind an axe with the government, but rather to get you to think. Think about your privacy. How much do you really have? Who might be invading yours? It's easy to chuckle at my editorialization, marvel at the equipment we'll be describing, and simply shrug off this entire article. That would be your loss.

SURVEILLANCE HARDWARE

Interception (or 'bugging' if you must use the term), can loosely be described

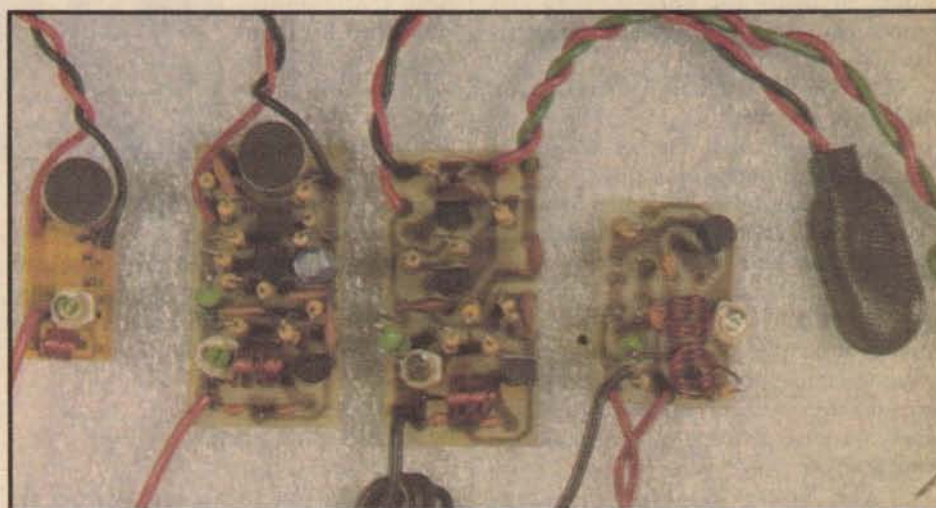


PHOTO 1

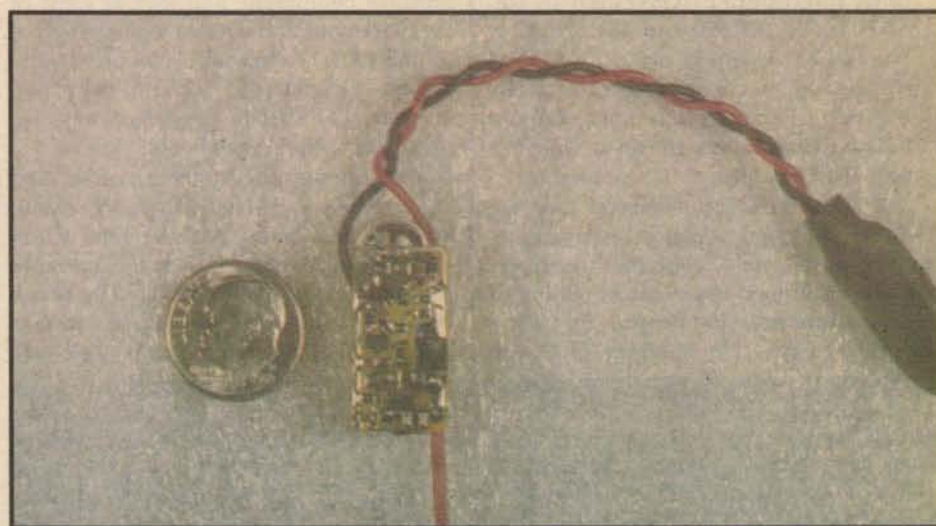


PHOTO 2

as the covert acquisition of audio (e.g. conversations) from a room or a phone line. Telephone intercepts (or 'wire taps') usually require some form of physical connection to the target phone line to acquire the intelligence. A room or ambient audio interception device requires some type of microphone to pick up the audio from the target room.

No matter which type of intercept is taking place, once a surveillance device acquires audio, it needs to convey the sound to a monitoring post or tape recorder. This can be accomplished in several ways.

One way is called 'hardwiring.' This is where an actual pair of wires lead from the intercept device to the recorder or

monitoring post. Since the risk of being discovered is greater when such wiring is required, most devices use another means of conveying audio to the eavesdropper. The most popular being radio frequency (RF) energy.

TRANSMITTING INTELLIGENCE

Converting the audio energy from an intercepted conversation into RF energy is the most common method used in surveillance. This avoids the problem of running wires and allows the surveillance operator to receive the intelligence without the necessity of being physically connected to the intercept device. The unit can be constructed as one small, bat-

tery-operated package. In the case of wiretaps, the intercept device can even be powered by current from the phone line. This type of unit is often referred to as a 'telephone leech' for obvious reasons.

The output power of these devices is small. Usually far less than one-half watt. A higher output power requires a larger device, thus making it more difficult to conceal. More power also increases the current draw, necessitating more or larger batteries to power the unit. Since higher output power also increases the range, the chance of someone else inadvertently receiving the transmission is greater.

What frequencies do these units transmit on? Just about any, in theory. Miniature transmitters not intended for law enforcement use usually transmit within the FM commercial broadcast band. To prevent accidental discovery by someone else tuning through stations on their stereo, the unit may be tuned just above or below the normal range of a standard radio and monitored on a scanner instead.

The FCC allows law enforcement agencies to utilize any frequency assigned for police radio services, whether licensed to the particular police department or not, as long as the device transmits at a very low power. The majority of police departments have their bugs and body mikes crystallized to tactical frequencies between 160-170 Mhz.

Again turning to *Full Disclosure* magazine, we can review bid lists submitted by various agencies for surveillance equipment to look at some of the requested frequencies:

The Texas Alcoholic Beverage Commission was seeking bids on two body microphones crystallized to frequencies of 161.020 and 161.620 Mhz, both to be equipped with PL (CTCSS) tone squelch encoders of 162.2 Hz. Rockland County (New York) wanted bids on transmitters tuned to 151.6375 and 154.5275 Mhz.

Where there is some distance involved between the target premises and the monitoring posts, small, concealed repeaters may be positioned in a nearby building or vehicle to increase the range. These may be tuned to similar frequencies, or as with

What do all these units look like? Well, you're limited only by your imagination. The heart is obviously a small circuit board or boards and a microphone. The packaging of commercial units available include cigarette packs, functional digital pagers, cellular telephones, desk lamps, clocks, and the plain old small glob of epoxy containing the 'guts.' You have to conceal these yourself.

Interesting to note that remote-controlled transmitting video cameras are available from several manufacturers built within dummy high-voltage transformers. Bolted to the top of an electric pole with a few wires attached to provide power and an appearance of functionality, who would suspect the surveillance equipment inside?

THE ARSENAL OF GLADYS KRAVITZ

Let's turn our attention away from the world of law enforcement and professional equipment, and look at some of the more common devices within reach of us plain folk. While all of the professional gear is crystal-controlled to lock transmissions on a specific frequency, much of the low-end equipment is not.

Free-running oscillators are often used because they are inexpensive and require little power. Tuning of these units is usually accomplished via a small variable capacitor in the tank circuit. The disadvantages are associated with frequency drift, especially as related to temperature

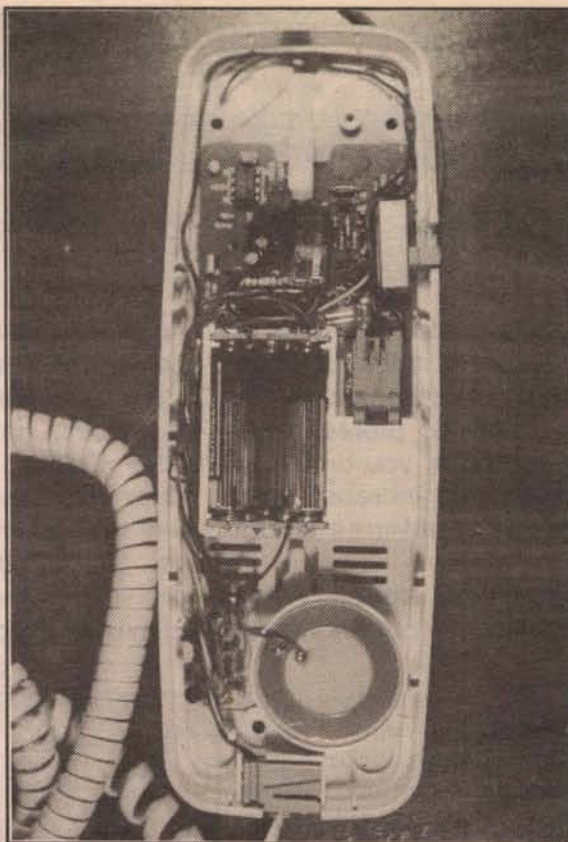


PHOTO 4

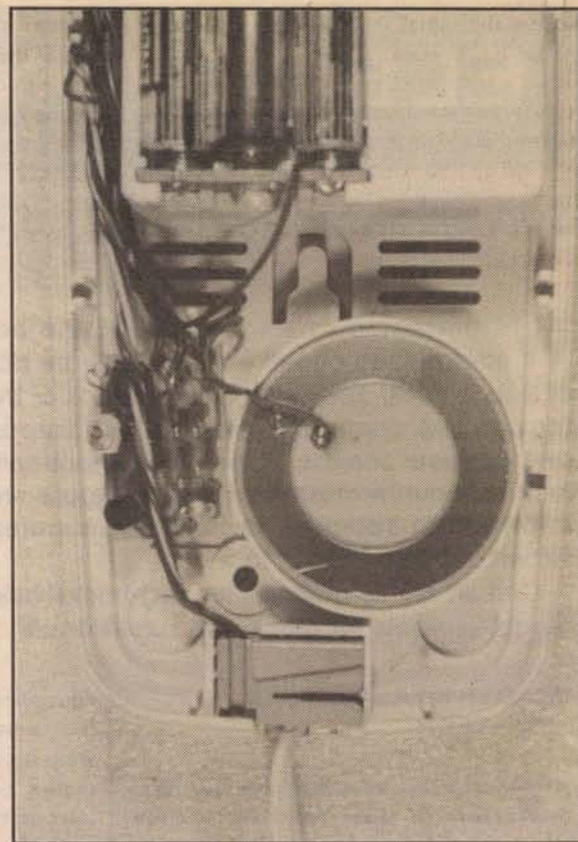


PHOTO 5

these units from an advertiser here in Nuts & Volts: Xandi Electronics of Tempe, Arizona. (See 'Sources' sidebar for additional information.)

To give you a better idea of how small these transmitters are, take a look at Photo 2. This is a close-up of the opposite side of the device farthest to the left. Just larger than a dime, Xandi's micro-miniature wireless microphone utilizes surface-mount technology for the ultimate in compact size. Although sold as a kit, all the surface mount assembly is done for you. All you need to worry about soldering is the mike leads and a few wires.

After construction, the two units on the left become small transmitting microphones, and the units on the right transmit audio obtained from, oh, perhaps a telephone line. As a convenience to monitoring your phone calls from another room on a permanent basis, the rightmost device draws its power from the

below, see if you can detect the unit. Please **don't** practice intercepting conversations. Neither Xandi Electronics, myself, or anyone at Nuts & Volts would ever encourage you to break the law. Please take a moment to read the legal notice accompanying this article.

COUNTERMEASURES BASICS

Electronic countermeasures to surveillance is something that is best left to the experts for practical purposes. We're going to check out some basic techniques that can be fun to experiment with, but are probably useless against a professionally planned attack on your privacy. While there are many people who claim to be countermeasures experts, few are truly able to deliver on their promises. Extensive experience and about \$50,000 in equipment is required for an effective countermeasures sweep.

Now don't get depressed - an inexpen-

DISCLAIMER

Please be aware that electronic eavesdropping is a criminal offense at both the federal and state level. Mere possession of devices intended for eavesdropping is also a violation of federal law. Do not conduct experiments in a fashion that may result in your subscription address changing to the local jail.

Nothing in this article or sidebars should be construed as legal advice or counsel.

long-range transmitters often used to deliver video signals from a hidden camera, may be in the microwave range.

In short, interception devices can transmit on any frequency in the spectrum, from DC to daylight (as the popular saying goes).

Two alternatives to straight RF include the use of laser or infrared light to convey the intelligence. The problems with these technologies are the fact that light travels in a straight line. The transmitting element and receiver element would have to be in line-of-sight for these to work. Spread spectrum technology, formerly used mainly by the military for communications, has reportedly been pressed into service with surveillance devices, making them difficult to intercept or detect.

changes and aging of the battery supplying power. As mentioned before, most of these units are tunable across the commercial FM broadcast band. Many devices sold as "FM wireless microphones" fall in to this category.

Photo 1 depicts four miniature devices that could be used by the fictional Gladys Kravitz to gather intelligence on one of her neighbors. Gladys could, of course, end up in prison merely for possessing these units if proven she intended to use them unlawfully as interception devices. Since sales and possession of 'bugs and wiretaps' is prohibited by federal law except to law enforcement agencies, these units are sold as kits, which is completely legal.

So completely legal that I obtained

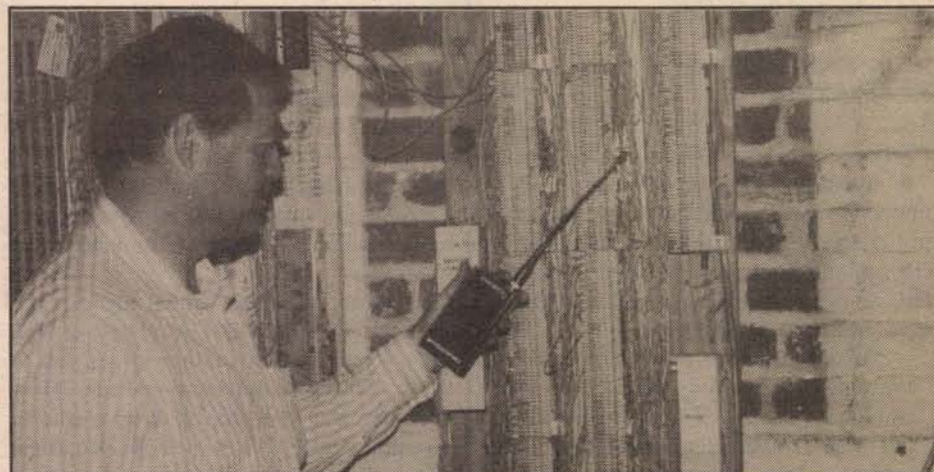


PHOTO 3

phone line itself. You would never have to worry about replacing the battery.

These kits are fun to play with, and are inexpensive if you want to try your hand at countermeasures. Build one and go hide it. Using information presented

sive transmitting microphone can still be detected with inexpensive equipment. Since the device emits radio waves, this fact can be exploited and the RF detected with a frequency counter or receiver. You just have to be close to the unit to

pick up the signal.

We were able to locate all four of Xandi's transmitters using both a hand held frequency counter and a "near field communications receiver" manufactured by OptoElectronics called the "FM Interceptor." Both units operate on the same principle: each locks on to the strongest FM signal received by its antenna. The counter displays the frequency, while the Interceptor actually demodulates the audio from the transmission and lets you listen on the unit's speaker.

For either of these methods to work, you need to almost be on top of the transmitter. Photo 3 depicts the ever-vigilant Alan Capone sweeping the telephone company demarcation point at his business. Should there be an inexpensive transmitter (sometimes known as a 'throw-away' because the person planting it never expects to go back and recover the unit), hidden behind the crunch blocks or using any of the phone lines as an antenna, he stands a good chance of detecting it with the Interceptor near-field receiver. If the unit is operative.

One of the major problems faced by countermeasures pros is discovering devices that only transmit intermittently. Many phone taps do not operate unless the line is actually in use (off hook). This increases the battery life and reduces the chance of discovery using these types of methods.

While you certainly can increase your RF security using a frequency counter and/or near-field receiver, these aren't the techniques relied on by the professional. At minimum, a countermeasures sweep of the RF spectrum will involve the use of a very sensitive spectrum analyzer and a computer-controlled communications receiver. The ICOM R-7000 and R-7100 are two of the more popular radios used for this purpose, and several units are

designed specifically for countermeasures, such as the "Scanlock" receiver.

In these instances, each and every signal detected is investigated. It is a time-consuming process, especially since the sweep should include checking for more sophisticated transmission methods such as single-sideband (SSB) or carrier current signals being sent through your AC wiring.

The most important aspect of any sweep is the physical search. Intercept devices can often be found using the five senses that are missed by all of the electronic equipment. Take a look at Photo 4. Inspect it closely, because there is more inside this phone than originally placed there by the manufacturer. Check out the area to the left of the electronic ringer (and I bet you didn't even recognize that flat piece of metal was the ringer unless you've examined the innards of a cheap electronic phone...).

Photo 5 is a close-up of this area, and that small circuit board does not belong in the phone. It's a line-powered leech (series transmitter). An assembled Xandi Electronics unit to be precise. And it took me less than two minutes to wedge it in the phone base, connect two wires to the phone line, and wrap the antenna around in the base (the black wire visible near the switch hook).

Without simply launching into a monologue describing different techniques of planting and detecting electronic surveillance devices, there isn't much more I can say on the subject. Since there are already entire books which discuss these devices and methods in some detail, read the "Sources" sidebar if you'd like to learn more. The publications reviewed will get you off to a great start and blow your mind in the process.

Always remember: There's a Gladys Kravitz in every business and in every neighborhood!

TECHNICAL SURVEILLANCE COUNTERMEASURES

PROFESSIONALS VS. DOG & PONY SHOWS

Technical Surveillance Countermeasures (TSCM) is the industry term for a professional 'sweep' designed to locate illegal devices used for electronic surveillance. This information is presented in order for you to understand what to expect from a high quality sweep performed by a reputable agency.

Here you will learn how to avoid being taken in by the many "Walter Mitty" types whose firms claim to be countermeasures experts. The material in this sidebar was thoughtfully provided by the president of SWS Security located in the Maryland area. His company is one of the leading manufacturers of surveillance equipment (available only to government agencies), and one of only twelve TSCM experts endorsed by the Army Security Agency awhile back on a referral list for private sector government defense contractors.

Based on his expertise and the demand for his services, I agreed not to use his name or publish his address. His corporate phone number is unlisted. I was not only impressed by his honesty and lack of pretense, but the fact that he does not stand to personally profit by providing this material. He's not trying to drum up business; he's just concerned about the reputation of the TSCM industry and ultimately you - the client.

If you are a corporate CEO and believe you need a consultation with SWS Security, contact a reputable private investigator for a referral, or drop me

a note on your letterhead and I'll forward it. What follows are the words of this ex-employee of a three-letter agency, and any errors or omissions are to be blamed on my editing, not his source material.

SELECTING A TSCM TEAM

If you have reason to believe your privacy is threatened, you need the services of a counter-surveillance professional. The TSCM consultant will work with you to assess the threat and perform a series of services to determine whether you are on the receiving end of surveillance operations.

The consultant you call in might determine that you need a "sweep." A sweep, as it is called, is an inspection of a facility designed to identify and locate any hidden surveillance devices. Let's discuss sweeps:

There are several basic eavesdropping techniques, all of which must be considered separately in a comprehensive sweep. All require different skills, equipment and procedures. One is called an "RF" sweep and refers to anything involving a radio transmitter, including power line transmissions. This is the one most people picture when discussing sweeps, but in our experience the least likely to be a threat.

Second is wire communications intercepts (WCI), also called 'telephone taps' by people who act like they know what they're talking about. Thirdly, direct wired concealed micro-

phones are a consideration.

It must be said sooner or later that many, probably most, of the guys peddling sweep services are incompetent. A large percentage are outright thieves who have no real capability to perform TSCM but who are lured into the field by dreams of big bucks. Include in this category the hotdogs who are caught up in the glamour of the whole thing.

Also among the incompetents are the vast majority of burglar alarm companies, telephone installers, 'security' companies and private detectives who just can't turn down the money. These types regularly get calls from the general public who don't know where to find the real thing. I apologize to the extremely few detective agencies who genuinely have TSCM capability. You know who you are. The bottom line is that it's very easy to get ripped off, and very difficult to find a competent TSCM man.

While we're discussing qualifications of a TSCM professional, you should understand that it's pretty much mandatory for a counter-surveillance man to have had experience on the other side of the fence ('Positive' work - e.g., conducting intercept operations for a law enforcement agency or the government). How can someone who's never conducted technical surveillance for a living expect to know much about countering sophisticated attacks?

Writing, teaching, advertising or visibility in the industry does not in any way substitute for true covert experience, usually with a federal agency. The guys who have been there can't talk details, and the guys who haven't will die of old age before they pick up enough experience on the outside to be truly effective at TSCM. A lot of TSCM wannabees will fill your

ear with their war stories. The true professionals don't talk much.

Is it true that empty barrels make the most noise?

TSCM work is always a sideline even for the professionals, who pay the bills by selling equipment, teaching, writing or some effort allied to the field. Although the equipment inventory in no way relates to the quality of services available, TSCM gear is necessary to perform the service. With a typical minimum investment of \$35,000 - \$50,000 in equipment, the payback would be so slow as to make the field a very poor investment.

Ensure that the prospective vendor has a solid engineering and practical background. TSCM is not purely a theoretical science. An extensive knowledge of how intercept devices themselves function and how they are installed and configured is vital, though. Here is where you want to be dazzled with brilliance, not baffled with goat droppings.

Don't hesitate to ask pointed technical questions, which you should be in a position to do if you've done your homework. Be suspicious if you don't get responsive answers. Many times the ripoff artists are so ignorant that they can't even discuss their equipment or proposed techniques intelligently.

Insist that they communicate with you in terms you can understand. Have them define technical terms and buzzwords. Make them speak English, not alphabet soup. Don't accept any nonsense about "proprietary" information - you deserve to know what you're being asked to pay for. Any competent professional will be rightly proud of his skills, and will be capable of explaining his work so that any reasonably educated person can understand.

SOURCES

WHERE TO FIND PRODUCTS AND ADDITIONAL INFORMATION

The individual who likes to keep up-to-date with 'insider' information on the current happenings in the world of surveillance would do well to consider subscribing to *Full Disclosure*. Published in the format of a small newspaper, *Full Disclosure* reveals many of the techniques used to invade privacy. From computer databases to hands-on reviews of the latest high-tech vehicle tracking systems, the scoop can be found in this publication. Subscriptions run \$18.00 for twelve issues.

FULL DISCLOSURE, Box 903-NV7, Libertyville, IL 60048

TRANSMITTER KITS

The transmitter kits described and pictured in the main article are inexpensive and easy to construct. Look for the ad in this issue from Xandi Electronics, or you can obtain a free catalog of their complete line of interesting transmitters, bug detectors, etc. They offer a 30-day refund policy on their products.

XANDI ELECTRONICS, Box 25647, Tempe, AZ 85285-5647
Orders: (800) 336-7389 Tech Support: (602) 894-0992

INFORMATIVE BOOKS AND VIDEO TAPES

A company called Intelligence Incorporated (or 'I-squared') in the San Francisco Bay area is kind of a Wal Mart of surveillance products and information. Professional level equipment tends to be expensive, yet these guys offer pretty reasonable prices on a broad range of products, including computer database searches.

If you want to know how surveillance devices work, this could be your one-stop shop for publications and video tapes. My personal favorite is a book entitled *How to Get Anything on Anybody - Book II* by Lee Lapin. Far exceeding the scope and detail of his original *How to Get Anything...* publication, *Book II* is a goldmine of information on surveillance, manipulation and other forms of intelligence gathering. After reading it cover to cover, I've personally caught on to several attempts via phone and mail to manipulate personal information from me. Once you know how it's done, you have the ability to protect yourself.

Charles Jaco of CNN News is quoted as saying "[This is the] best book on surveillance and investigations I've ever seen. Really scary stuff." If I could only have one book on the subject, this would be the book I'd choose. *How to Get Anything on Anybody - Book II* sells for \$34.95 + \$5.00 shipping and 8% California sales tax.

Two other decent books include *Hands-On Electronic Surveillance* and *Hands-On Countermeasures*. A series of instructional video tapes is also available, and the one I've watched on performing computer database searches was fascinating. Your best bet is to drop them a line and request a copy of their catalog. It is enlightening reading by itself!

INTELLIGENCE INCORPORATED, 2228 S. El Camino #349, San Mateo, CA 94403
FAX (415) 851-5403

A total TSCM package costs. Don't be surprised at a healthy four or even five-figure fee. By the same token, don't expect much more than a dog and pony show for a few hundred dollars. Unfortunately, the shysters charge top dollar right up there with the big boys, so the fee structure is no indicator at all as to the quality of the work.

Beware of any firm who guarantees they will find something. There are firms who promise this, and sure enough - they do. Whatever they 'find' wasn't there before they showed up. Beware also of any firm who claims they can find everything there is to find. This is a claim made by many amateurs, and no professionals. Finding a hidden transmitter, microphone or whatever is worse than finding a needle in a haystack. Maybe it's like trying to find a needle which may or may not be there, is disguised as a piece of hay, and you're wearing Kevlar trousers.

THE PHYSICAL SEARCH

This next part is important, so pay attention. Virtually every sweep is composed of two parts - the actual electronic search and a physical search. Sometimes this is a way to separate the men from the boys. For every device

found with the electronics, ten are found during the physical. The physical search is absolutely necessary, and the only way to find many hard wired concealed microphones. Dead transmitters (previously planted, currently inoperative due to dead batteries or remote shutdown) can only be detected with either a physical or via an unreasonably expensive device known as a non-linear junction detector (NLJ).

The physical search is necessary, and believe me, it's dog work. It involves a thorough examination of anywhere a device could be hidden in a facility. This includes furniture, appliances, electrical fixtures (a favorite hiding place), air ducts, office equipment, inside hollow doors or walls, above drop ceilings, below raised floors, inside or behind art objects, clocks, emergency lights, smoke detectors - the list goes on and on.

Don't underestimate the necessity of a physical search. Many of the pretty boys can't be bothered to get their hands dirty, so be sure you are getting the whole thing.

Don't hesitate to check around if you have any doubt about the individual with whom you are negotiating for services. Your guy should welcome this. The more informed you are, the less likely you are to be cheated. NV

FULL DUPLEX

COMMUNICATION

with Damien Thorn

"Full Duplex" is an interactive column with Nuts & Volts writer Damien Thorn. We'll be reprinting the more interesting letters from readers along with Damien's responses. Questions, comments about his articles or ideas for future issues are all welcome. Correspondence should be sent directly to Damien Thorn, 6333 Pacific Avenue, Suite 203, Stockton, CA 95207. He can also be reached electronically at 75720,2104 on CompuServe or as DrDamien@Delphi.com via the Internet. Names will not be published if anonymity is requested.

CELLULAR SOFTWARE REVIEW - NOT!

Whether the topic is Hispanic youths toting laptop computers on the street corners of Los Angeles, or a certain advertisement appearing in this magazine, I've had a lot of conversations about 'cellular software' lately. At first it was just another interest on my part, but after hearing tales of young gang members selling ESNs and reprogramming phones in Southern California, I've become fascinated with the subject. The image of a youthful criminal snaking a serial cable through someone's car window to alter the serial number of a phone using a laptop computer is absolutely compelling. Drive up to get a new identity for your phone instead of buying drugs. Are gangs going high-tech?

The vast majority of us have a much more legitimate and legal interest in cellular software. It appears to offer an easy way to make a duplicate of an existing, activated phone so that we may have two units with only one number. Not just a savings of a monthly "activation" fee assessed by the cellular carrier, but the convenience of one phone number. Seems legal, and if performed with software using innate capabilities of certain phones, you wouldn't run the risk of getting in trouble for

physically modifying FCC type-accepted hardware by replacing a chip.

Last month I explained that I wanted to review the software package offered by a certain advertiser, but had yet to receive it. Both the advertiser and the publisher of a cellular modification handbook (who are friends or in some way affiliated) had assured me that I would receive a loaner copy for evaluation. That was more than three months ago. The last contact I had was a message on my answering machine from the advertiser indicating he had been out of the country when I called, but would get the software right out. Over a month and another magazine deadline later, I've not heard or received anything.

While the price is close to \$500.00, I understand that the package consists of a floppy disk and some documentation. You have to build your own cables, or purchase them separately for a few hundred dollars more. The program is supposed to allow you to reprogram and/or change the ESN of several older Motorola units, a few NEC units, Panasonic models and two of the Mitsubishi series phones.

Although I feel badly that I'm unable to provide more information or deliver on my promise of a hands-on review this month, I hope you can see that it is not through lack of effort on my part. Perhaps there is something to be learned here. Why would an advertiser

repeatedly promise to loan a product for review and then fail to deliver? I'll spare you my cynical guess.

ASSISTING LAW ENFORCEMENT

While we didn't receive a plaque or certificate, I was pleased to discover that our continuing coverage of cellular technology has been of benefit to law enforcement personnel in addition to the communications technicians and experimenters who read the magazine. This is a composite of several letters I received via CompuServe mail from a peace officer in New York:

Dear Damien,

I recently picked up a Xerox of an article you wrote in the December (1992) issue of Nuts & Volts Magazine, and thought it was a great article. I called N&V and started my subscription.

I am a member of the National Technical Investigators Association (NATIA) and at a recent meeting they distributed the article. NATIA is an organization of law enforcement personnel involved with the electronic aspect of law enforcement. We use many different types of monitoring and surveillance equipment ranging from 35mm cameras to very sophisticated electronic equipment. The majority of the work for our tech group involves support of narcotics investigations. I find the job challenging and a constant learning process.

From your article I was able to get into the programming mode of a handheld Motorola. I could not get into a different unit, even though it was the same model phone so I back ordered a copy of the January issue in order to build the programming aid to allow me to gain access.

I hope to obtain a programming template for an Audiovox CMT-550 phone installed in the vehicle I use at work, because I cannot punch in a telephone number for a digital pager. It appears that the long tone DTMF is disabled.

If you reprint any of this letter, please do not publish my name. I spent four years as a crime scene technician and have received much exposure on television already. People love to see knives, guns and bullet casings being picked up, so we did it while the cameras were present. It was fun watching the TV crews crowding in to get the key footage to make the news story more interesting, but now I avoid publicity completely.

Name Withheld
New York

It was amusing to note how law enforcement agencies routinely copy and distribute copyright material within their ranks. I was reminded of all the outcry by police complaining and holding demonstrations over rapper Ice-Cube's song called "Cop Killer." Working in radio, I attended several of these and in each case noted that the cassette of the song played at the press conference was an illegal dub.

Don't get me wrong - I'm not complaining about the NATIA duplicating my work for educational use because I'm happy to make a positive contribution. Besides, Nuts & Volts is the copyright holder of my articles and it is up to the publisher to complain about such things, not me. Any law enforcement group requiring technical information or wishing to engage me as a speaker is certainly encouraged to contact me.

The Audiovox phone mentioned above is not reprogrammable through the keypad.

Being an older model, a PROM burner is required to update any of the parameters in the numeric assignment module (NAM). Only phones manufactured within the last few years can be reprogrammed from the keypad. Your agency or the NATIA can receive more complete information regarding this unit from Audiovox. Their address is 60 Arkay Drive, Hauppauge, NY 11788.

Damien

Dear Damien,

About five years ago, I subscribed to Nuts & Volts but dropped my subscription because of uninteresting articles and items being repeated over and over, month to month. I received a sample issue in December and I must admit, I subscribed once again mainly due to your article on cellular telephone programming. I have since sent a letter to the editor commending your articles.

Your article prompted me to buy a used cellular phone to be used in conjunction with my existing phone. I would like to duplicate the ESN to be able to use the new portable type phone when I am not in my vehicle. If I am unable to do that, I would surely settle with doing the programming myself and get a second number. I do not feel that the \$50.00 charged to program a phone is really justified.

I would appreciate anything you can send on the phone which is a Panasonic model EB-2501, and want you to know that this information will really be appreciated!

Your article in the last issue suggested that someone feels your articles might promote more theft of services. I certainly do not feel that this is so. I do feel that your articles educate those who have a sincere desire to learn more and helps us feel good about saving outrageous programming fees charged by cellular companies. I personally look forward to your articles in Nuts & Volts and hope they continue for a long, long time.

Joey
Moultrie, Georgia

Dear Joey,

Thanks for your letter. We're pleased that you've found the evolution of Nuts & Volts to be to your liking. The magazine has come a long way, and I'm genuinely excited to be participating in its growth.

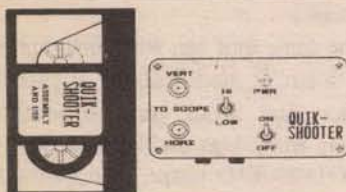
Changing the ESN on your phone is not a matter of programming. It requires you to locate a physical integrated circuit within the phone (a memory device such as a PROM), and obtain an identical, unprogrammed chip. After removing the IC from the phone you would need to place it in a PROM programmer and read it. The new PROM would be programmed like the old one, except you substitute the serial number of your other phone.

This is a pretty complex task itself, unless you own a PROM burner and are familiar with these types of memory devices. What makes 'cloning' an even more daunting task is the fact that the ESN is sometimes encrypted (old Motorola units), or requires some non-standard checksum be computed and programmed. Some units use custom, proprietary VLSI integrated circuits and you cannot obtain replacements 'off the shelf' for reprogramming.

Damien

#150 PLANS — KITS — SCHEMATICS cont.

LOGIC ANALYZER, 25MHz, 16 channel, PC based. Plans and SW, \$10 to: R.G. Brown, 30 Wicks Rd., East Northport, NY 11731.



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SELL: TECHNICAL manuals maintenance, full operation, schematics mil. receiver BC-348(R) (+ other code letters ONE T/M) \$26 postpd.; Want: TM and/or Sony computer #SMC-70. D. Testa, P.O. Box 9064NV, Newark, NJ 07104.

KITS: DF "Handi-Finder" (QST 5-93) with case & antennas, without battery or handle: \$19.50 pp. Baycom packet (TCM3105): \$22 w/floppy. Smart Charger gell/lead (UC-3906): \$14. 3 IC 0-100MC spectrum analyzer: \$32. Postpaid board & board parts only. **SASE** for flyer: **R&R Associates**, 3106 Glendon Avenue, Los Angeles, CA 90034.

SHORTWAVE CONVERTER. Converts any AM radio to shortwave. Hear Moscow, London, China, etc. Great introduction to the hobby of shortwave listening. \$13 kit, \$15 assembled. Sent postpaid. Neace, 512 Park Hills, Frankfort, KY 40601.

SCHEMATIC CAPTURE/PCB software. PADS, ISIS, & OrCAD. Includes LOG/ic PLD compiler and more! Full working shareware packages. 1.2M or 1.44. \$29.95. **VISA/MC/COD** 1-602-782-2316. **TELECODE**, Box 6426-NV, Yuma, AZ 85366-6426.

GREETINGS AGAIN from Wilted Turkey Waddle Wyoming! We are **REVERSE ENGINEERS** by trade and over the last mega years have torn apart and drawn schematics of 1300+ electronic gizmos. We offer these prints for sale in 24 catalogs. A list of these catalogs and an explanation of our services can be had (no Colorado or Canada) if you send us 4 stamps. **BOMARC SERVICES**, Box 1113, Casper, WY 82602.

BUILD SOLID state relays 3-32 VDC input AC output using Triac of your choice, plans and parts list \$9.95. Fred Cranshaw, 1624 Bitter Ck., Garland, TX 75040. 214-494-4917.

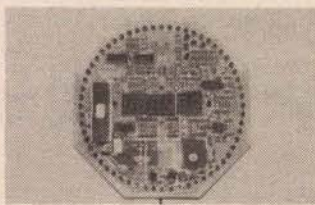
DIMMING STROBE schematic, with controller. Very bright, common parts. Plus schematics for simple AC and DC strobes. \$9. Northlight, 3370 Hayden Rd., #123-149, Scottsdale, AZ 85251.

AMPLIFIER PLANS. 30MHz 12 watt driver, 60 watt 225-400 MHz, 2 to 30 MHz 140 watt and 300 watt pep plans only. Send \$12 postpaid USA MO to: C. Hipkins, P.O. Box 5025, Wilmington, DE 19808.

WILL BUY, plans or kit form: Smart Kit "Oscilloscope Components Tester." KB2DMY, Box 25, Ransomville, NY 14131.

MC68HC705C8 PROGRAMMER. Includes power supply, ZIF socket, PC programming software. Kit \$103.50. Info, **SASE**. SCS, Box 680, New Hartford, CT 06057-0680.

MAGNETIC AMPLIFIER. Solid state amplifier without semiconductors or vacuum. Amplifies through the use of magnetic fields. Plans, \$10, kit (plans + one amplifier) \$20. **ELECTROMAN**, Box 24474, New Orleans, LA 70184. 504-482-3017.



HYPERCLOCK KIT. As seen in the Feb. 1992 issue of Radio/Electronics and the 1993 Electronic Experimenters Guide. Guaranteed to be the most unique LED digital clock you will ever build and own. Eight display modes including "before the hour minutes indication" and "fading digits" give HyperClock that unique one of a kind look. A ring of 60 LED's indicate seconds or estimate tide levels. An hour chime, full wake up alarm functions, and battery back-up features are included. Full electronic kit \$75, Red Plexiglas Case \$12, S/H \$4 or send for brochure to **SkiTronix**, P.O. Box 9685, Spokane, WA 99209.



SILENT SAM turn signal reminder. Best reminder yet. Doesn't bug you. Sounds briefly at intervals if you forget to cancel. Price \$22.00 Visa/MC. Call 1-800-398-5605. Free data.

VCR SERVICE Manuals 1989 and earlier. Panasonic, Quasar, Magnavox, Emerson. \$20 each shipped Cont. US. Dale Andrews, 3830 Colina Lane, Waco, TX 76705-3626.

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Manual

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AUTO/MANUAL RANGING DIGITAL MULTIMETER HITACHI, #VR-3525. Eight function 3 1/2 digit hand-held multimeter. Measures AC and DC voltage, AC and DC current, resistance, continuity. Also will measure temperature when used with optional probes (available from Hitachi). Unit also has diode check function. Input impedance 10 meg ohm or better. Ranges include 200 mVDC to 1000 VDC, 2000 mVAC to 750 VAC, 0 to 20 meg ohm resistance, 200 uA to 10 amps AC or DC current, -20° to +700°C temperature measurement when used with probe #4261 (not included or available from C&H). 0-1000 mV @ .6 mA diode test. New, complete with instruction manual. Requires 2AA batteries for operation, not supplied.

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Model 1390 Random Noise Generator.....\$100.00

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Model 1346B Audio Frequency Microvoltmeter.....\$90.00

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World's smallest FM voice transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip (SMT) parts are pre-assembled to the circuit board.

XST500(E-Z) Kit \$44.95

• Transmits both sides of phone conversation.
• Adjustable from 88-108MHz.
• Works with any FM broadcast receiver.
• Up to 1 mile range.
• Turns off when phone is not in use to extend battery life.

XTT100 LONG RANGE PHONE TRANSMITTER
Similar to our very popular XSP500, the XTT100 is battery powered for maximum range. It plugs into any phone jack and transmits all calls on that line.

XTT100(C) Kit \$32.95

XLC900 800-950 MHz SCANNER CONVERTER KIT
If your scanner can receive 400-550 MHz, just add the XLC900 for uninterrupted 800-950 MHz coverage. It converts all 800-950 MHz signals down to 400-550 MHz so your scanner can receive them! Add our custom case and knob kit for that "professional" look.

XLC900 Kit \$49.95
XLC-Case Kit \$13.95

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World's smallest FM phone transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip (SMT) parts are pre-assembled to the circuit board.

XSP250(E-Z) Kit \$34.95

• Super sensitive, hear every sound in a house!
• Powerful 2 stage audio amp.
• Use with any FM broadcast receiver.
• Up to 1 mile range.
• Powered by 9V battery.

XFM100 MINIATURE FM TRANSMITTER
The XFM100 has a super sensitive microphone and is capable of picking up sounds at the level of a whisper and transmitting them to any FM broadcast receiver.

XFM100(C) Kit \$32.95



• Digital voice changing: male to female, female to male, adult to child, child to adult.
• 16 levels of voice masking.
• Button for normal operation.
• Complete anonymity on all calls.



TRANSITION 2000 VOICE CHANGING TELEPHONE
STOP THOSE ANNOYING PHONE CALLS! Sound older and tougher when you want to. Not a kit, fully assembled. Single line phone operation only.

TRANSITION 2000 \$89.95

• Transmits a continuous beeping tone.
• Adjustable from 88-108 MHz.
• Up to 1 mile range.
• Works with any FM broadcast receiver.
• Operates at battery voltages of 3 to 18 volts.

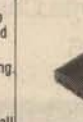
XTR100 TRACKING TRANSMITTER
Measuring 7 by 2.4 inches, the XTR100 is ideal for use in locating lost model rockets, bicycles, automobiles, games of hide-and-seek, and contests.

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XLA1000 Kit \$24.95
XLA-Case Kit \$13.95

• Digital voice changing: male to female, female to male, adult to child, child to adult.
• Use with any modular phone.
• Connects between handset and phone.
• 16 levels of voice masking.



TRANSITION 2001 VOICE CHANGING Accessory
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TRANSITION 2001 \$59.95

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• Compact hand held unit.
• Uses Miniature loudspeaker (not included) for audio indication of detected signals.

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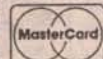
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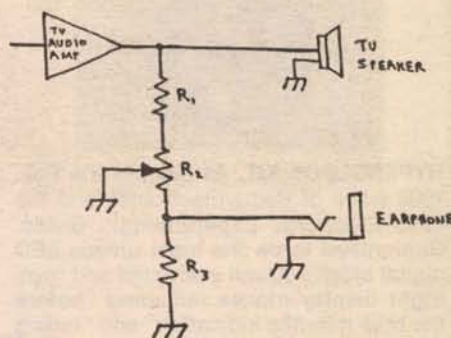
**CALL
TODAY!**

TECH FORUM

Continued from page 40

ANSWER TO #6935 - JUNE 1993

Even though you may be using high input impedance earphones, they still may not be able to handle the power that the television's audio amplifier is supplying to them. The earphones require a voltage divider circuit, as shown.



This circuit provides the resistance necessary for the power tolerance of the earphones. R_1 sets the minimum resistance required to prevent earphone overload. R_2 is a potentiometer that acts as a volume control for the earphones. To determine the proper resistance for R_1 , measure the output voltage from the TV's audio amplifier, compare it to the rated input voltage limit of the earphones, and use Ohm's Law (Resistance = Voltage divided by Current) to determine the upper resistance limit. R_2 prevents interference from ground. No transformer is needed to match the stereo aux input; only one of the two earphones will process the mono audio signal. The other earphone is not used, unless you have the jack wired in such a way that the mono signal is applied to both earphones. Even in this case, no matching should be necessary since loads with higher input impedances have less capacitive circuit loading characteristics. As long as R_1 is high enough, no damage should occur to the speakers or the TV.

**Frank Reiser
Caldwell, NJ**

ANSWER TO #6939 - JUNE 1993

The plug-in chip upgrade for a 386SX is the 387 numeric co-processor. This chip will greatly speed up math intensive programs such as spreadsheets or video games. The chip is about \$60 and fits into a motherboard socket.

Not all computers will support (address) 4mb SIMMS, although it would be unusual to find a 386 that wouldn't. I talked to Tandy, and they tell me that your model will accept a 387 chip and 4mb SIMMS.

**K. Bay
Saskatoon, SK CANADA**

ANSWER TO #69310 - JUNE 1993

Magnetic-stripe cards (such as credit cards) may be read using the Mag Stripe reader from American Microsystems, 800-648-4452 or 817-571-9015 in Texas.

(Mention Nuts & Volts Magazine when you call.)

The same unit can write information with a circuit modification, or you can buy a second "write" unit. To modify the reader, add a bias oscillator in the 100KHz-200KHz range, then adjust frequency, bias voltage and signal voltage just as you would on a tape recorder.

**Peter Skye
Glendale, CA**

ANSWER TO #6934 - JUNE 1993

The BIOS in XT's will not support high density floppy drives because these drives were not in existence when the XT was produced. There are after-market BIOS replacements which will allow support for the high density floppy drives but the controller may still not support them. The best way to add the capability of high density floppy drives is to get a controller which contains a RAM BIOS (battery backed up) that will intercept the floppy calls and control a high density drive. These are sold by Nuts & Volts advertisers under the names of XT Super Floppy Controller (<\$30) or XT Multi I/O Super Floppy Controller (<\$50) if serial/parallel/game ports and clock are needed since this board would replace your existing controller card. Contact the sellers about your situation.

**Dan Violette
Orange, CA**

ANSWER TO #5937 - MAY 1993

The Macintosh 128K, 512K and 512K Enhanced came with either an RS232 or an RS422 interface. If you are unsure which type your computer has, look behind the DB9 connectors on your motherboard. An RS232 port will have 1488/1489 level converters and an RS422 port will have 26LS30/26LS32 level converters. The pinout for the interfaces is as follows:

RS232

1 signal ground
2 +5V
3 signal ground
4 transmit data +
5 transmit data -
6 +12V
7 handshake input
8 receive data +
9 receive data -

RS422

1 frame ground
2 nc
3 signal ground
4 nc
5 transmit data
6 nc
7 data set ready
8 nc
9 receive data

In either case, you can then build a converter to change your input/output signals to TTL using 1488/1489's for RS232 or 26LS30/26LS32's for RS422. Each set of devices converts its appropriate level to/from TTL.

**Paul Klebaur
South Berwick, ME**

SOLDERING IRON temp controller kit. Triac based, PCB level kit, \$10. Makes your \$4 iron adjustable. 714-777-7738, FAX: 777-3382.

FREE SHORTWAVE. Convert any AM Radio to receive worldband shortwave signals for pennies. Instruction booklet, \$10. **ELECTROMAN**, Dept. NV, P.O. Box 24474, New Orleans, LA 70184.

DIGITAL SYNTHESIZER: 4x5 inch board generates low distortion sine waves. DIP switch sets one hertz steps to 524KHz. SASE for specifications. \$69.95 + \$5 S/H, complete kit. Novatech Instruments, 1530 Eastlake East Suite 303, Seattle, WA 98102. 206-328-6902, FAX 206-328-6904.

MANUALS - SCHEMATICS WANTED

155

WANTED: COLLINS Radio Company, catalogs, promotional literature and manuals from 1933-1985. Jim Stitzinger, 1-805-259-2011, FAX 1-805-259-3830.

WANTED: SCHEMATICS for: Thordarson tube amplifier with two 2A3 outputs. Futherman H3 Amp with six 6FW5 tubes/channel and finally, tube preamp made in Japan #U-BROS-1. Paul Gil, 180 Union Ave., Belleville, NJ 07109. 201-751-5959.

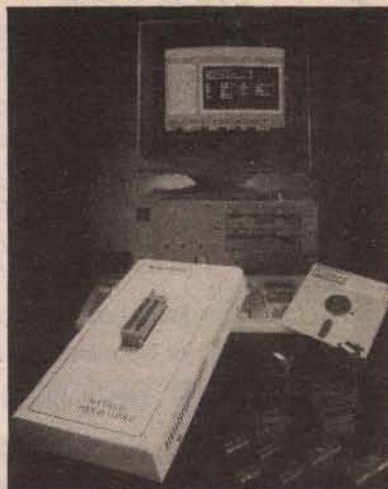
NEED SCHEMATICS: GE VCR Model V67500, RCA VCR Model VLT388, Pioneer Stereo Model SX780. Also wanted Kodak/Verbatim 3.3 MB disks. 404-476-0368. Buswell Compuserve 76054,2707.

PHOTOFACT SETS AND BOOKS wanted. SAMS or manufacturers. Send list and price. A.G. Tannenbaum, P.O. Box 110, E. Rockaway, NY 11518. 516-887-0057, FAX 516-599-6523.

WANTED: TEST EQUIPMENT SERVICE MANUALS! For late model Hewlett-Packard, Tektronix, Fluke, Wavetek, and ESI test equipment. Pepper Systems, 214-353-0257.

MICROFICHE READER. Dual page, micro design. Must be in mint condition. 717-992-5233 or postcard to J. Heeney, P.O. Box 850, Stroudsburg, PA 18360.

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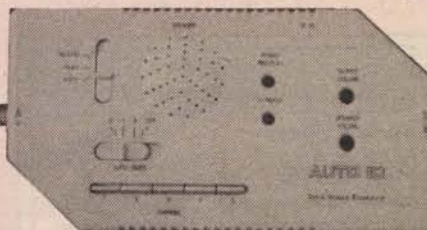
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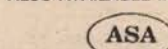
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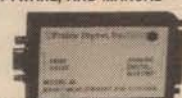
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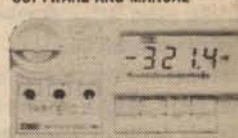
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NEW PRODUCTS INTRODUCED

Keystone Electronics Corp. is introducing several new products for various electronic applications.

BLADE FUSE PC SOCKETS

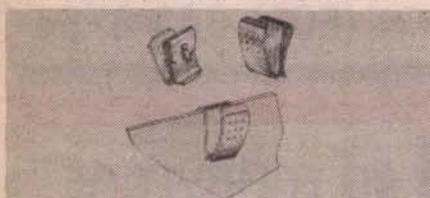


A new series of printed circuit mount sockets which accept automotive blade fuses is available in two configurations — a dual contact type for use with single position fuse mounts and a triple contact socket which offers the versatility of alternate position mounting.

Compatible with Bussman ATC fuses and Littelfuse #257 fuse series, the new Keystone sockets are designed to retain stable positioning during wave soldering and will resist solder wicking. They feature spring brass contacts which maintain retention qualities even after numerous insertions and withdrawals.

Contacts for these new auto blade fuse sockets are bright electro-tin plated with insulators made of glass-filled black Nylon, UL rated 94 V-0. Operating temperatures for the sockets range from -50°C to +145°C with current and voltage ratings of 500VAC at 15 Amps max.

SNAP-ON AA, AAA & N BATTERY CLIPS

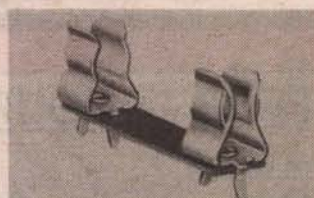


Designed to be positioned over the edge of molded cases or panels that are .060 to .070 thick, these Snap-on clips for use with AA, AAA and N batteries are anchored by sharp barbs that eliminate the need for special grooves, slots or holes.

Additional features include an easy access external solder "ear" to secure the wire for soldering and embossed contact dimples for snag-free battery insertion.

The clips are manufactured using nickel plated, spring tempered steel which provides the necessary contact leg tension to assure proper electrical contact and to take up any variation in battery length.

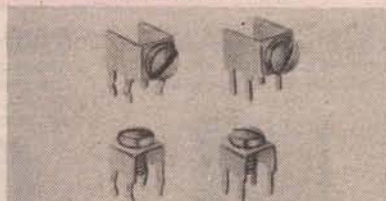
SNAP-IN PC MOUNT FUSE HOLDER



A new, Snap-In PC mount fuse holder has been developed and is available for immediate delivery.

This low profile, space saving device will accept all .250 dia., 3 AG fuses and features snap-in contacts to facilitate wave soldering while offering low contact resistance. These fuse holders utilize tin plated brass clips and .032 thick G-10 Phenolic, UL rated 94V-0.

PRINTED CIRCUIT MOUNT SCREW TERMINAL CONNECTORS



Keystone Electronics has expanded its selection of horizontal and vertical type screw terminal connectors to include both snap-in PC mount and standard PC mount models.

These new, multipurpose connectors are alternatives to screw type edge connectors, barrier blocks, screw terminal boards and strips. They are manufactured from .032 thick brass, tin plated, and are supplied with 6-32 x 1/4" long steel, zinc plated, binding head screws unassembled or installed and captivated.

Designed for high density packaging, these low profile 15 Amp connectors accept 14-22 AWG wire. Both the standard PC mount and the snap-in PC mount types are designed to retard wicking.

SURFACE MOUNT COIN CELL HOLDERS



These new SMT single and dual holders for 20mm diameter, 3 Volt Lithium

coin cell batteries are constructed using a lightweight, rugged, UL approved Stanyl-46 Nylon base which has a temperature range of -60°F to 540°F. Contacts are made of .015 thick steel, plated tin over nickel.

Specifically designed to meet the necessary requirements of surface mount applications, these coin cell holders offer a variety of features including: "slotted" tails for higher solder joint strength; clearly marked polarity; low profile for high density packaging; and a unique "sloped" entry configuration which makes battery installation and replacement simple, without compromising retention.

Ideal for pick-and-place SMT assembly, the holders are made to accept all major battery manufacturers' Lithium coin cells.

VERTICAL 9V PC BATTERY CONNECTOR



Major features of this new, insulated, one-piece construction PC battery connector include suitability for wave soldering, and anti-wicking design, plus a low profile, space saving configuration.

This connector is manufactured with .080 dia. by .400 long, tin plated brass pins, with nickel plated steel battery contacts and a .062 thick grey fiber insulator. It mounts in two .086 dia. holes on .500 centers.

For more information regarding any of these products, contact:

KEYSTONE ELECTRONICS CORP.
31-07 20TH ROAD, DEPT. NV
ASTORIA, NY 11105-2017
TEL: 718-956-8900
TLF: 800-221-5510
FAX: 718-956-9040

ELECTRONICS LAB IN A COMPUTER

Interactive Image Technologies now has available *Electronics Workbench*, a software program that is a virtual electronics laboratory for your DOS or Macintosh computer.

This simulated laboratory enables you to design, modify, and prototype an electronic circuit in less time than traditional proto-

typing methods.

The program provides unlimited access to eight professional test instruments from an autoranging digital multimeter, bode plotter, logic analyzer to a dual-trace oscilloscope for either analog or digital circuits.

The instrument simulations are carbon copies of the real thing. If you know or want to know how to use precision test instrumentation, this software will help.

Electronics Workbench provides access to an infinite number of components of every conceivable value and tolerance. If your circuit works in Electronics Workbench, it will work in the real world.

As a result of placing the circuit in this environment, schematic diagrams and parts lists are automatically updated and available for printing from your dot-matrix or laser printer. Circuits created can also be saved on computer disk, and can be modified at any time.

With Electronics Workbench you have access to professional test instruments and unlimited electronic components in a safe electronics testing environment. The program comes with a comprehensive manual. The DOS version sells for \$299 and the Macintosh version for \$199.

For a free information kit contact:

INTERACTIVE IMAGE TECHNOLOGIES LTD.
908 NIAGARA FALLS BOULEVARD
SUITE 068, DEPT. NV
NORTH TONAWANDA, NY 14120-9901
TEL: 800-263-5552
FAX: 416-368-5799

AUTO ADAPTER FOR NOTEBOOK COMPUTERS



A universal automobile adapter for notebook computers is now available from Statpower Technologies Corp.

Operating from any 12V battery source, NOTEpower recharges and operates any notebook computer by converting power from the vehicle's cigarette lighter socket.

A true DC to AC inverter, NOTEpower converts 12V DC power to 115V AC power producing up to 50 watts of power.

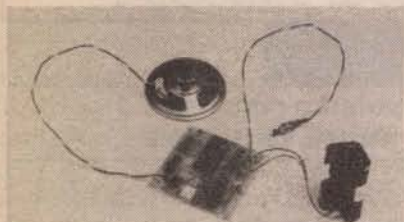
NOTEpower is an AC outlet in the car,

allowing operation of battery chargers and AC adapters for cellular phones, camcorders, power tools and other rechargeable equipment.

The suggested retail price for NOTEpower is \$89.95 Cdn. To find out more, call or write:

STATPOWER TECHNOLOGIES CORP.
7725 LOUGHEED HIGHWAY, DEPT. NV
BURNABY, BC V5A 4V8
604-420-1585 • FAX 604-420-1591

DIGITAL SPEECH WITHOUT A COMPUTER



Deus Ex Machina Engineering announces the introduction of SoundByte Jr. — a \$49 stand-alone digital speech playback board.

The 3-inch square board, which operates from 3 AA cells, plays a predigitized message stored in EPROM at the push of a button. Because the speech is recorded rather than synthesized, it can play a message in any language — it's even possible to play low-fidelity music or other sounds.

Typical uses are: amateur radio, advertising and promotions, site alarms, games and amusements, test systems, warnings and announcements, process control, and devices for the disabled.

The EPROM data is created using a \$119 PC-based system and a telephone handset. The system allows you to hear the message as it will sound before burning the EPROM. A variable data recording rate (25 kbps to 50 kbps) lets you maximize sound quality for a given message length and EPROM size.

SoundByte Jr. can accommodate up to a 4 Mb EPROM, which provides 2 minutes of telephone-grade speech (35 kbps). Because of the variable data rate, the smallest EPROM — 256 kb — can store a 5 to 10 second message.

The board comes with a 15-second demo message, loudspeaker, battery holder, and pushbutton. An OEM version of the board is available for \$25 in 100 piece quantities.

Further details can be obtained from:

DEUS EX MACHINA ENGINEERING, INC.
1390 CARLING DRIVE
SUITE 108, DEPT. NV
ST. PAUL, MN 55108
PHONE: 612-645-8088
FAX: 612-645-0184

TAPE BACKUP SYSTEM

ADPI announces a new PC tape backup system that supports both Macintosh and IBM compatible computers.

The portable, dual-port system connects to the SCSI port of the MAC, or the parallel port of the IBM compatible without add-in cards or special cables. One complete system can support all DOS PCs, Macintosh computers, and network file servers in the office.



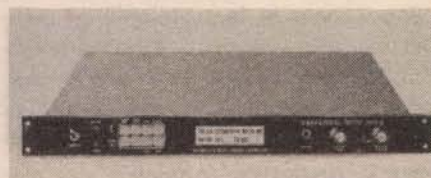
Some of the unit's features include: user friendly software; backup speed up to 12 Megabytes per minute using a standard parallel or SCSI port; complete Macintosh network support; selective backup restore modes; span large backups over several tapes, or backup small tasks on one tape; automatic read-after-write verification; unattended backup scheduler for Macintosh; top quality hardware; and a portable size.

Applications include: multiple MAC, PC, laptop & notebook backup; CAD and desktop publishing; field sales and service requirements; software distribution; confidential data control; and archive storage.

For more details, contact:

ANALOG & DIGITAL PERIPHERALS, INC.
P.O. BOX 499
TROY, OH 45373
513-339-2241 • FAX 513-339-0070.

COMMERCIAL SCPC AUDIO RECEIVER



The new Universal SCPC 300-C, available from Universal Electronics, is a high-quality, microprocessor-controlled audio broadcast receiver which incorporates the needed features for broadcast use.

There are no extra frequency boards needed to put you on any SCPC frequency, as the SCPC 300-C is fully frequency and transponder agile with a push of a button. No coding schemes are used for selection of its parameters and features.

Full readout of SCPC frequency, transponder, bandwidth, de-emphasis, companding and memory channel in use are displayed on an easy-to-read, super-twist LCD display of two lines with 20 characters per line. All companding boards, 3:1, 2:1, 1:1 are built in and are standard features.

The SCPC 300-C has 50 non-volatile memories, which are recalled at the touch of a single button to select any SCPC channel in the set 50 to 90 MHz area,

Continued on page 115

CABLE TV DESCRAMBLERS NOBODY BEATS OUR PRICE!

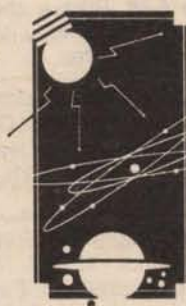
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H-P P382A Variable Attenuator	(2 avail.) \$485.00
H-P 3455A 5 1/2 Digit Digital Multimeter	\$695.00
H-P 8756A Scalar Network Analyzer	\$3625.00
H-P 8754A 4-1300 MHz Network Analyzer	\$4695.00
Tektronix TM506 Mainframe	(2 avail.) \$215.00
Tektronix PG502, Pulse Generator for TM500 Series	(2 avail.) \$1095.00
Tektronix SC502, Oscilloscope	(2 avail.) OFFER
Hewlett-Packard 5342A 18 GHz Counter	\$2895.00
Tektronix AM503 with P6302 Current Probe for TM500 series	\$1195.00
Tektronix 475 Oscilloscope	\$700.00

All items are limited to one unit unless otherwise noted.

ALL Equipment is in good working order and comes with a ten day right to refusal.

A calibration certificate is available at an additional charge. All prices are C.O.D. Payments made on an approved open account or major credit card are subject to a surcharge. Customer is responsible for shipping charges.

Write in 157 on Reader Service Card.

Nuts & Volts Magazine/July 1993

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CABLE TV DESCRAMBLERS & CONVERTERS!

NEW - 550 MHz SUPER CONVERTER ! PANASONIC 1453G

- 5 YEAR WARRANTY
- WORKS ANYWHERE
- 550 MHZ PROVIDES 99 CHANNEL CAPACITY
- STD/HRC SWITCHABLE
- SLEEP TIMER WITH AUTO SHUT-OFF
- PARENTAL GUIDANCE CONTROL
- FAVORITE CHANNEL SELECT
- LAST CHANNEL RECALL

CONVERTERS

	100	50	10	5
PANASONIC 1453G W/REM	\$ 55	57	59	64
VIEWSTAR 2010 W/REM	34	36	40	45
JERROLD 450 OR 400 W/REM	35	37	40	45

COMBINATIONS

Below units are new or refurbished. All are "unmodified" and equipped with decoders.	100	50	10	5
JERROLD 400DRXDIC	\$ call	call	49	54
JERROLD 400DRZDIC	call	call	48	53
VIDEO TAPE DECODER	call	call	19	24
FILTER CH3	call	call	7	9
FILTERS ALL OTHERS CHANNELS	call	call	9	13

CH2 CONVERTERS

STARGATE, REGAL, JERROLD DQN7 w/ or w/o volume
ALSO NEW REMOTES FOR VARIOUS UNITS
CALL FOR SUPER LOW PRICES !

AS-IS UNITS

Call for more info and extra volume discounts The MORE YOU BUY the MORE YOU SAVE	5
JERROLD 400 CH 2 OR 3	\$ 5
JERROLD 400 OR 450 DIC CH2 OR 3	10
HAMLIN CRX 5000 - CRX 6000 - 3M	10
OTHER CONVERTERS	5
REMOTE CONTROLS	2

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Terms: Prepayment or COD. We don't accept charge cards to keep our prices low. Minimum 5-lot order is necessary to get these low wholesale prices and to qualify you as our dealer.
All listed prices are subject to change without notice - be sure to confirm your order. **Theft of cable is a crime.** INTELLIVIDEO will not knowingly defraud any pay television operator and we will not assist any company or individual in doing the same. Anyone implying theft of service will be denied purchase. **Wholesale sales to dealers only.**

#155 MANUALS—SCHEMATICS WANTED cont.

WANTED: SCHEMATICS for intelligent fast-chargers for NiCd, NiMH, and lead-acid gels. Prefer simple. Will pay small copy/shipping charges if necessary. Also need pin-out for Motorola flip-phone accessory socket. DC, Box 5298, Temple, TX 76505.

NEED SCHEMATICS and service manuals for Systron Donner 6153-50 counter, Texcan VS20, VS40, VS80 sweepers. Send details and price to: George Merrell, 618 N. Ave. C, Kermit, TX 79745. 915-586-3189.

WANTED: SCHEMATIC for Zenith Laptop ZFL-171-42. Will pay. W5LVA, 8705 E. 63rd Tfwy, Kansas City, Mo 64133-4703, or call 816-354-6309 anytime.

WANTED: ADVENT service manual for Videobeam Model 710 projection TV, manufacture date 5-78. Please contact Bob Premovich, 355 Seneca Way, Monument, CO 80132. 719-481-4768.

WANTED: MAINTENANCE/Operator's repair manual and parts list for a Canon PC-200 copier. Send price to: L.E. Nyman, 3704 Woodlawn Drive, Eveleth, MN 55734.

NEED: SCHEMATIC diagram for Varmint Linear Mobile Amplifier, XL-600. Model #600M, Serial No: NPG-6766-15T. Pay top dollar. Radio Alignment, P.O. Box 352, Galveston, IN 46932.

WANTED: SERVICE manual for CEI Communications Electronics, Inc. VLF receiver, Type 354-1. Original or copy. Ph: 305-223-5228, FAX 305-553-4461.

WANTED: SERVICE info/manual for Ricoh FAX22. Will pay copy costs plus I will buy you lunch. Call Brian, 215-233-3233.

WANTED: SCHEMATIC for telephone ringer (buzzer) loud type utilizing a relay. For outdoor use or where I can obtain a complete unit. A. Gehbauer, 105 W. Park Blvd., Braithwaite, LA 70040-1825.

MISCELLANEOUS ELECTRONICS FOR SALE

160

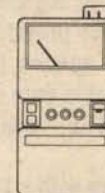
BNF CLOSEOUTS. Stiffening cap. Car audio 100K MFD cap \$13, \$60/5, \$100/10, Wind Speed Indicator Kit \$5, \$13/3, Tesla Coil Kit \$15, Fan/Motor Speed Control \$3, \$10/4, 2 1/2" I.D. 1 1/2" D. Solder Pot \$3, Voice/Sound Activated Switch Modu. \$1, Components by the foot asst. \$1/10", 4 x 10 car/TV speakers \$2, \$10/6, 2 speed SW. Motor/lamp control \$1/2, 12/\$5, CRT 12" Glare Filters 2 types plastic & mesh \$1 or \$5/6, 12" CRT for IBM 5150 monitors green new \$19, \$55/3, Security Keylock Switch, 2 Keys \$3/2. We have 5 ads. Send SASE for our flyer. BNF, 119 Foster St., Peabody, MA 01960. T508-532-2323, F508-532-1040.

UNINTERRUPTIBLE POWER SUPPLIES. Two SCI 10KVA UPS units, one in Chicago, one in California, \$995 each, 120V output, no batteries. Three each 3KVA units, 220V output, Deltec 7036R, one in San Jose, one in Las Vegas, \$995 each. 5KVA inverter, \$650, located in California. 702-386-2844.

HOW TO buy a used shortwave receiver \$6 ppd. Complete catalog of patriot/right wing books \$1. Bohica Concepts, POB 546-NV, Randle, WA 98377.

ANAHEIM WIRE PRODUCTS. DISTRIBUTOR OF WIRE AND CABLE since 1973. Items available from our stock: Plenum Cable, PVC, Multi-Conductor, Teflon Wire, Hook-Up Wire, Irradiated PVC, SO-Cord, Telephone Wire, Shrink Tubing, Automotive Primary, Building Wire, Mil-Spec Wire, Welding Cable, Battery Cable. If interested, please call 714-520-0540, FAX 714-520-5548.

UHF AMPLIFIERS Masthead type. New with P/S and hardware only \$10 each or 3 for \$25. Dave, 414-272-0781.



DRIVESAFE ALCOHOL TESTER. Test your breath with the Drivesafe Alcohol Test Computer. Size 5 1/4 x 2 3/4 x 1 1/2 in. Weight 8.6 oz. Fits in glove compartment. Uses 6 AA batteries (not included) \$34.95 plus \$2.00 shipping. Visa/MC OK. 30-day money back guarantee. H.T. Orr Computer Supplies, 249 Juanita Way, Placentia, Ca 92670. 714-528-9822, 800-377-2023, FAX 714-993-6216.

GIANT SOLAR PANELS \$44.00 EACH! Excellent Prices/Solar Equipment, Accessories. Free Information send stamp, Catalog \$3.00 To: Quad Energy, P.O. Box 690073, Houston, TX 77269. 713-893-0313.

WIND ENERGY. How to build permanent magnet wind generators video tape \$39.95. Will custom build 300 to 30,000 watts, interface inverters and solar equipment available. Ribic's Wind & Solar Enterprises, W 8319 Sunset Hwy., Spokane, WA 99204.

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NEW PRODUCT NEWS

Continued from page 113

allowing one SCPC receiver to receive many SCPC channels with any transmission parameter in use.

The new receiver has two high-quality phase lock loop synthesized frequency converters to achieve stable reception. There are two outputs, a 600 OHM balanced line out and a 4 to 8 OHM speaker out, plus front panel headphone monitoring jack.

The input frequency of the unit is 950-1450 MHz and it can be used with any modern stable LNB or LNA with a suitable downconverter. The SCPC 300-C is fully C Band and Ku Band compatible and furnishes LNB/LNA DC voltage, plus polarity control.

Standard rack mounting of 19" wide, 10" deep, 1.75" high or a standard shelf case cabinet 17" wide, 10" deep, 1.75" high with 115 VAC, 60 cycle power requirements—other power requirements available.

For further information and pricing, call:

UNIVERSAL ELECTRONICS, INC.

4555 GROVES ROAD, SUITE 13

DEPT. NV

COLUMBUS, OH 43232

614-866-4605 • FAX 614-866-1201

ELECTRONIC CONNECTOR COMPONENTS INCLUDE PLASTIC INSULATORS AND SPACERS



Custom engineered microwave and electronic connector components that can be machined from a wide variety of plastics such as Teflon®, Rexolite® and Torlon®, or metals, are available from Queen Screw & Manufacturing, Inc.

Queen Screw's microwave and electronic connector components can be precision machined in sizes ranging from 0.050" to 1.75" O.D. with $\pm .0005$ " tolerances. Engineered to customer requirements, typical parts include insulators, spacers, washers, and fittings produced in accordance with MIL-I-45208A.

Capable of providing complete assemblies with mounting nuts machined from brass, steel, or aluminum and contact pins machined from beryllium copper or brass, Queen Screw's components can be supplied in prototype through production quantities. Secondary operations include cross drilling, slotting, milling, and broaching.

For more information contact:

QUEEN SCREW &

MANUFACTURING, INC.

49 FARWELL STREET, DEPT. NV

WALTHAM, MA 02154

617-894-8110 • FAX 617-894-0907

Events CALENDAR

Continued from page 92

SEPTEMBER 11

GA - STATESBORO — Statesboro Hamfest '93. **SPONSOR:** Statesboro Amateur Radio Society. **LOCATION:** Kiwanis Fairgrounds. **HOURS:** 8am-4:30pm. **ADMISSION:** \$3. **TALK-IN:** 147.105+. **FEATURES:** EX - FP - RV - S - T. **DEALER INFO:** Inside booth \$10 incl. admission. **CONTACT:** R.D. Franks, POB 402, Brooklet GA 30415. 912-842-2744.

MA - WILMINGTON — Computer Show. **LOCATION:** Shriner's Auditorium (formerly Woburn), I-93 exit #39, 4 mi N of I-95. **HOURS:** 10am-4pm. **FEATURES:** AC - C. **DEALER INFO:** 500 tables. **CONTACT:** KGP Computer Shows.*

MONTH AT A GLANCE

JULY 1993

JULY 3

CA - Glendale - California Computer Show & Sale*
CA - Santee - Electronics Swap Meet
CA - Ventura - MarketPro Computer Shows*
PA - Lehman - MURGAS Amateur Radio Club Hamfest

JULY 3-4

NJ - Cherry Hill - Star Ware PC Dealer Showcase
VA - Weston - West Virginia State Convention

JULY 4

CA - Livermore - Livermore ARC Swap Meet
NY - Suffern - Tri-State Computer Fairs*
PA - Harrisburg - Harrisburg RAC Hamfest

JULY 9-10-11

ND - Dunseith - International Peace Garden Hamfest

JULY 10

CA - Los Altos Hills - Foothill College Flea Market
CA - Oceanside - Oceanside Swap Meet
CA - Riverside - MarketPro Computer Shows*
CA - San Francisco - CA Historical Radio Society Swapmeet
CA - San Jose - California Computer Show & Sale*
CO - Denver - R&L Computer Fair & Flea Market*
DE - Dover - Tri-State Computer Fairs*
MI - Livonia - Computers & You*
MI - Petoskey - Straits Area ARC Swap & Shop
MI - Westland - Great Lakes Computer Show & Sale
MO - Springfield - Missouri State Convention
NC - Salisbury - The Triple States RAC Firecracker Hamfest
OR - Salem - Northwest Vintage Radio Society Swap Meet
SC - Summerville - Trident ARC Charleston II Hamfest
TX - Texas City - Tideland's Amateur Radio Society Hamfest
WI - Oak Creek - South Milwaukee ARC Swapfest

JULY 10-11

CA - Northridge - California Computer Show & Sale*
IN - Indianapolis - Indianapolis Hamfest & ARRL Conv

JULY 11

CA - Concord - MarketPro Computer Shows*
CA - Sacramento - California Computer Show & Sale*
CA - San Diego - MarketPro Computer Shows*
CO - Denver - Colorado Section Convention
IL - Downers Grove - DuPage ARC Hamfest
MD - Westminster - Summit ARA Hamfest & Computershow
MI - Madison Heights - Computers & You*
NH - Portsmouth - Northern Computer Shows & Sales
NJ - Augusta - Sussex County ARC SCARC '93
NJ - Cherry Hill - Tri-State Computer Fairs*
NY - Alexander - Genesee Radio Amateurs Hamfest
NY - Brewster - PEARLFEST Hamfest & Flea Market
OH - Bowling Green - Wood County ARC Ham-A-Rama
PA - Pittsburgh - North Hills ARC Hamfest

JULY 11-12-13-14

NV - Las Vegas - Video Software Dealers Convention

JULY 16-17

MN - Maplewood - North Area Rptr Assn Electronics Fair

JULY 16-17-18

MI - Lansing - Michigan Antique RC Extravaganza '93
MT - East Glacier Park - Glacier-Waterton Hamfest

JULY 17

CA - Oakland - California Computer Show & Sale*
CA - Pomona - Computer Marketplace Computer Show
CA - Santee - Electronics Swap Meet
FL - West Palm Beach - NARISAAM Computer Show*

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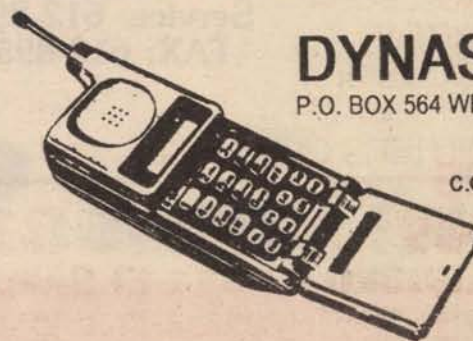
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IL - Rolling Meadows - Midwest Computer Flea Market
IN - Highland - Computer Possibilities Unlimited
ME - Union - Union Hamfest & Computer Fair
NC - Cary - Cary ARC Mid-Summer Swapfest
NH - Nashua - New England Antique Radio Club Swap & Sell
NY - Skaneateles - Skaneateles Lions Club Skanfest
OH - Wellington - Northern Ohio ARS Hamfest
WA - Vancouver - Portland ARC Elec & Comp Flea Market

JULY 17-18

GA - Atlanta - Southeastern Div ARRL Convention
PA - North Wales - Star Ware PC Dealer Showcase

JULY 18

AZ - Phoenix - Computer & Electronic Swap Meet
CA - Reseda - Computer Marketplace Trade Show
CA - Sacramento - MarketPro Computer Shows*
FL - Ft. Lauderdale - NARISAAM Computer Show*
IL - Orland Park - Chicagoland Computer Fair
MA - Cambridge - MIT Radio Society/Harvard Hamfest
MO - Washington - Zero Beaters ARC Hamfest
NH - Nashua - Northern Computer Shows & Sales
NJ - Secaucus - Tri-State Computer Fairs*
OH - Van Wert - Van Wert Amateur Radio Club Hamfest

JULY 19

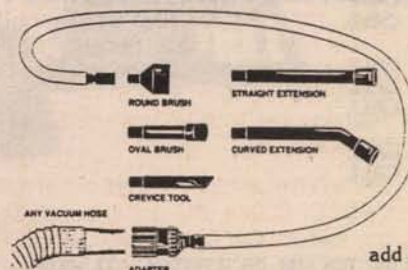
NC - Spiveys Corner - 25th Annual Hollerin' Contest

JULY 24

CA - Anaheim - California Computer Show & Sale*
CA - Oxnard - MarketPro Computer Shows*
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Continued on page 130

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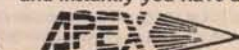
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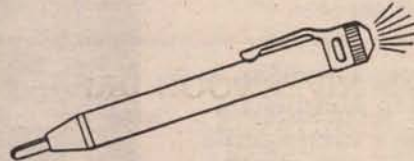
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NEWS ■ VIEWS ■ Reviews

MyFavoriteSoftware

by Fred Blechman

You probably won't see them advertised, but most software stores (including "wholesale" outlets like COSTCO) now carry brightly-packaged, inexpensive programs from MySoftware Company (1259 El Camino Real, Suite 167, Menlo Park, CA 94025; 415-325-9372).

MySoftware titles use the gimmick of starting with "My" and following with a title with no spaces and imbedded capitalization. I like most of them so much I call them, as a group, "MyFavoriteSoftware. Look for (among others) "MyPhonebook," "MyTreasures," "MyInvoices," "MyBackUp," "My Checkbook," "MyLabelMaker," "My DataBase," "MyMailList," and "My QuickWriter," with a subtitle of "Quick & Easy Series." The suggested retail prices run in the \$10 to \$25 range, with street prices often less!

More recently, MySoftware has come out with advanced program versions — the "Power Series" — with titles like "MyBusinessCheckbook," "MyAdvancedMailList" and "MyAdvancedDataBase," with suggested retail prices from \$40 to \$60. Originally, their products were only for the IBM PC, but recent releases include Macintosh and Windows versions.

I have many MySoftware programs, and find them outstanding values. Although their common claim of "Less than five minutes to learn" is somewhat optimistic, I find them much quicker to learn to use than most programs on the market, since they tend to operate similarly. Learn one and you'll learn the others very quickly.

Furthermore, most MySoftware programs are not demanding of special hardware, and even run fine on laptops. Many don't require a hard disk to operate, and those that do take little disk space compared to the obscene amount of hard disk real estate (8 megabytes or more) consumed by so many programs today. Unless you are a power user (and maybe even if you are!), you should be quite pleased with the speed, efficiency, ease of use, and value of MySoftware products.

Each package is nicely illustrated, showing typical screens and detailing the features. The documentation is minimal, usually provided in a small folder, with more detailed documentation in a disk file that is printed out with a program included on the disk. Since the programs are designed for ease of use, the documentation is not elaborate, and does not need to be.

MySoftware titles can be found at Babbages, CompUSA, Computer City, Egghead Discount Software, Office Club, Sears, Software Etc., Target, COSTCO and most other software stores.

MyBackUp

MyBackUp (over 100,000 sold) is a good example of an alternative to the expensive, space-hungry, hardware-demanding pro-

grams dedicated to providing archival backups to your programs. It's the one I use regularly. I love it!

It's a well-known fact that there are only two types of hard-drive computer users: those who have had a hard drive crash, and those who haven't had one crash YET! MyBackUp is so simple and easy to use that you won't find the backup process a hassle, and you'll tend to do it more often, being better prepared for that eventual hard disk crash.

MyBackUp overcomes the numerous limitations of the DOS BACKUP function. Everything is done from one easy-to-understand screen, as is the case typically in the MySoftware line. It really takes only a few minutes to learn this one. I use it every month or so, and don't even have to refer back to the simple documentation.

MyBackUp is fast. Even with its automatic verification feature engaged, you can fill a 360K diskette in less than 40 seconds. It handles hard drives and 360K, 720K, 1.2M and 1.44M 5.25-inch and 3.5-inch floppy disks. You can preset each floppy drive to the size you want, and the program even offers an "on the fly" formatting feature, so there's no need to prepare preformatted disks before backing up. You only need DOS 2.0 or higher (3.0 for 3.5-inch diskette), and 384K of RAM to operate MyBackUp. The intention is to back up to floppies. There is no provision to back up to tape drives; you'll need the "advanced" version for that.

No other backup software is easier to use. When the program is started, a single screen is divided into five windows that show directories, filenames, disk specifications, backup choices, and drive selections. A menu bar along the top of the screen lists five function keys, and each pulls down a window with a number of choices, or overlays a dialogue box on the screen.

All directories are listed in a tree format, and you can simply cursor over to find a specific file in any directory. Special characters indicate those files that have previously been backed up (a heart), those which are marked to be saved (a diamond), and those in the process of being backed up (a check mark).

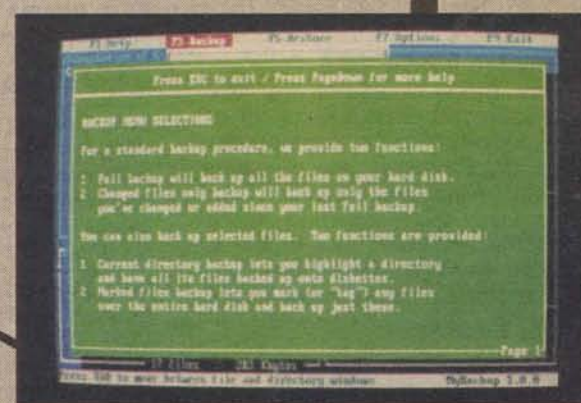
Function key F1 provides several screens of help. F3 brings down a window that lets you choose either a full backup, changed files only, current directory only, or marked files only. Cursor and Enter keys allow you to select and mark directories and files. F5 brings down a window offering a choice of restoring all, or selected file, or selected directory, or selected marked files.

Importantly, all files are saved in the standard DOS format (not compressed or encoded), so you can actually view and load (or copy) these files like any DOS files. The only exceptions to these are occasional "split" files that span backup disks. You see, MyBackUp tries to fill each disk. If a file is too long to fit on the current disk, it continues on the next one, with a SPLIT notation in the index. These split files must be recovered using the RESTORE function of MyBackUp. Auto-verifi-

MyBackUp shows all functions on one screen.

Press Function key F3 in MyBackUp and a menu pulls down offering four types of backup.

Press F1 anytime and MyBackUp provides four pages of HELP screens that overlay the regular screen.



cation double checks data integrity, and partial recovery is possible even if there are missing backup diskettes.

F7 offers several options. You can enable or disable sound warnings or high speed operation. You can change the density of your floppy drives. You can mark or clear all files, and you can get information about the creators of MyBackUp. F9 exits the program, saving all changes before exiting. The last backup disk used in each session contains a complete index of all sessions.

Another neat feature is that you can print a log of all backed-up filenames after each session, arranged by directory and subdirectory, for hard-copy reference. Also, a complete all-sessions index file, saved on the last disk of each session, is in ASCII (text mode), which you review with any word processor!

MyBackUp has a suggested retail price of only \$24.95 for a dual-media version (both 5.25" and 3.5" diskettes). If you can't live without Windows, or want to back up to tape drives, then get the extra-featured "MyAdvancedBackUp for Windows," which retails for \$59.95.

MyMailList

I have probably checked out a dozen different mailing list programs over the years, trying to find the ideal one. I wrote a series of programs for the IBM PC that I sell nationally ("AMBIZ-PAK - Computer Programs for Amway Product Distributors": \$49), and I need a mailing list of customers to send update notices every six months when Amway changes their product prices. MyMailList is the mailing list program I personally use. It does not require a hard disk, and will hold 800 records on a 360K floppy disk, or up to 5000 records on a 1.44M diskette or hard drive! You only need DOS 2.0 or higher (3.0 for the 3.5-inch diskette),

256K of RAM, and one disk drive. It will print various types of labels on all common printers, including lasers.

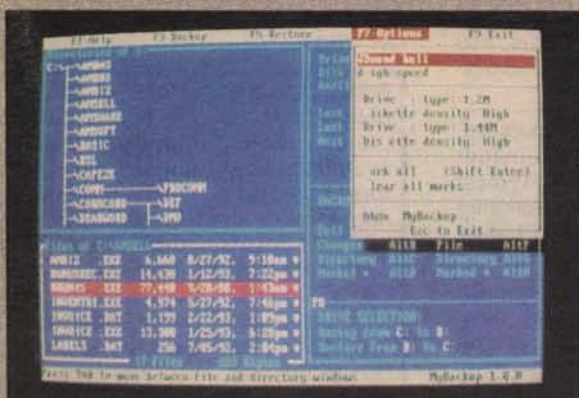
The documentation for MyMailList is only slightly over five pages. It is extremely easy to use, very versatile, and does everything with only one screen divided into seven windows. The Index window shows all the entries, as they are entered or sorted. You can scroll up or down this list, or page down 22 entries or 88 entries at a time, or jump to the top or bottom of the entire list.

The Entries window shows three records, each of which has the conventional name and address lines, but allows for a company name and a second address line, plus two lines of notes. There is no special line for a telephone number, but that can be in either of the two note lines.

The right third of the screen actually has five windows, each showing the use of the function keys F1-F5. F1 saves the newly entered records, and does not have to be used with each record. F2 allows you to sort by any of six choices, which you select with the up/down arrows. You can sort by last name, company, city, state, zip, or the first characters of the first note line (therefore allowing you to sort on Area Codes if you put the phone number on this first note line). F5 both saves and quits the program.

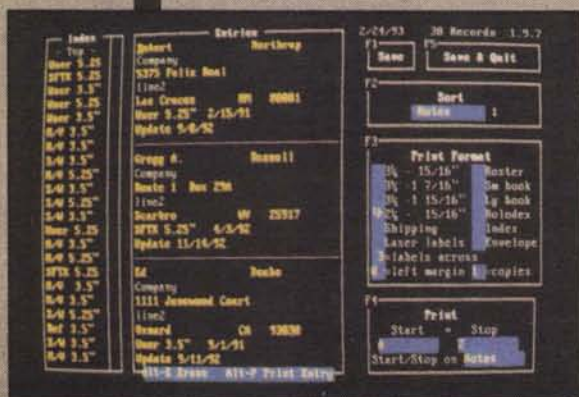
You can even do a two-level sort. For example, you can first sort by last name and then by state, and the names will be in order within the states. Also, since you can sort by the first note, you can use different codes to begin each note to create separate lists, such as a C for Customers, D for Distributors, P for Prospects, and so forth.

The other powerful feature of MyMailList is the many different types of printouts. Pressing F3 sends your cursor to the Print Format window, where you can choose any of 12 different print formats, with 1, 2, or 3



Press function key F5 in MyBackUp and a menu pulls down offering four restore choices.

Press function key F7 in MyBackUp and a menu pulls down with various optional setting choices, including setting the density of your floppy drives.



The MyMailList screen consists of seven windows, with three complete records in the Entries window.

labels across, and up to 99 copies! You can set the left margin for, say, envelopes, or odd labels. You cannot, however, create custom label formats. You can also set the printing range of where you start and stop within the sorted list.

A couple of immediate commands give you more control. ALT-E erases the entire record the cursor is on, and ALT-P prints the single record the cursor is on. 100 3-1/2" by 15/16" self-stick tractor-feed labels are included with this program.

MyMailList sells for \$24.95. About the only restrictions I found were that you could not format your own printout dimensions, and that the program does not provide for exporting or importing the records to or from a database or word processor, thus eliminating its use as a mail-merge list. MySoftware offers "MyAdvancedMailList" for \$59.95, which includes import, export, and other features.

MyCheckbook

MyCheckbook is a mini-accounting system without the typical CPA nomenclature. This is a dirty job, but somebody has to do it. If you have only one checking account, and you want to be super organized, you'll probably love MyCheckbook.

But be prepared to spend considerable time making initial entries within the limit of 50 categories and 100 payees. Once you do this, you'll be able to create checks with as few as three keystrokes for regular same-amount-every-month payments.

You'll need some patience getting acquainted with all the features of this program — and there are many. The seven-plus pages of documentation go into detail on all the program functions — too many to describe here.

The main left window shows two "checks" at a time. You make entries as if you were writing a check, even for deposits or other transactions. Other windows come into view when you request a list of categories or payees, each of which you customize as you go. Meanwhile, the right screen window keeps a running balance of your account or all the checks to a particular

payee or category.

There is a lot more to this program than meets the eye. You can set up budgets for each category, and can get nine different types of printed reports for any specified time period!

To test the program, I entered just one month's activity from my home checking account — 32 entries of checks and deposits. This was somewhat arduous, since I had to set up the categories and payees for each check as I went along. Next month will be a snap, since most transactions are repeats, and the program will actually print out the checks on forms available from MySoftware.

The printed reports, which can cover part or all of a year, are surprisingly extensive. If you like getting data summaries every which way, you'll love MyCheckbook! I used just one month and the Budget Report was one page; the Cash Flow Report (all four quarters) was four pages; the Category Report was three pages; the Payee Report was three pages; the Pocket Register (for your purse or wallet) was one page; the Reconciliation Report was one page; the Register was two pages; the Tax Deductible Report was three pages; and the Session Report was two pages.

Although you only need DOS 2.1 (3.0 for a 720K 3.5-inch diskette that holds 3000 checks!) and 384K of available RAM, I'd recommend using a hard disk with this program. It works with a single floppy (up to 700 checks even on a skimpy 360K 5.25-inch single-drive system), but some functions, like editing a check, take noticeable time as the data is reorganized and saved to a floppy disk. I'd also suggest that you read through the documentation after playing with this program awhile. Many shortcuts and features are described.

Also, bear in mind that if you have several checking accounts, you'll need to run these separately. MyCheckbook has a list price of \$24.95. The new "Power Series" version, "MyBusinessCheckbook," which sells for \$39.95, lets you manage multiple accounts of six different types, and multi-dimensional expense tracking lets you look at actual spending, budgets and variances by job or by department.

MyLabelMaker

Here's another super-easy-to-use program, and yet it has a surprising number of features. You can print four different standard size labels up to two across, and one standard size three across, with up to 9999 sets of labels. You can even specify sequential label numbering, such as might be used for admission or door prize tickets.

You can also customize the label with the number of lines of text (up to six), width (up to 40), and spacing top-to-top. This lets you produce labels for file folders, binders, 3 x 5 index cards, shipping labels, audio and video cassette labels, and more.

The program holds up to 200 entries, each of which can be coded by categories for sorting. DOS 2.0 or better (3.0 for 3.5-inch diskettes), one disk drive, and only 256K or RAM are required. There are no special type faces, graphics or fonts used, so any printer (including lasers) will do.

MyLabelMaker does not import or export data. Although MyMailList also prints name and address labels, MyLabelMaker is a much more flexible program for producing other types of labels, and provides numbering as well. Unfortunately, unless you get the "advanced" versions of MyMailList and MyLabelMaker, you can't import or export your data between them.

A single screen is used by MyLabelMaker. The three-plus pages of documentation detail some features, but they are really obvious in use, especially after using other MySoftware

programs.

The left Index window lists the 200 labels 23 at a time, based on the designation placed within the reverse video area at the top of each label. Three labels at a time are shown in the Labels window. An unshaded area represents your usable typing space. If you change the label size, the shaded area for that label changes. Neat!

Pressing F2 saves the file, F6 sorts by designation, F3 lets you set the printing parameters, F5 sets the sequential numbers (if used by designating ### signs within the label), and F8 quits the program. File saving is so fast that a hard drive offers no particular advantage over a floppy.

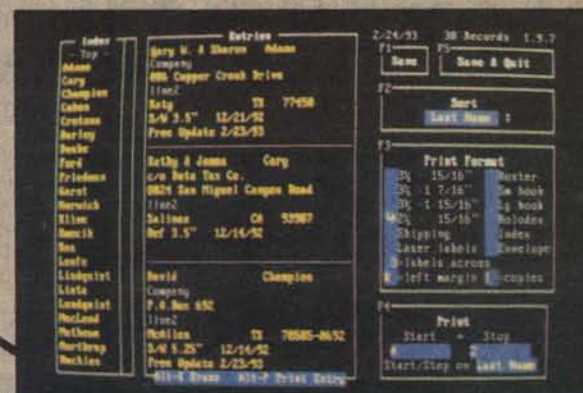
Other convenience keys are provided for quick operations. ALT-E erases a label entirely, ALT-X copies one label to another for minor changes or repeats, and ALT-C centers all the text on a label.

As you maneuver the cursor around the screen, the highlighting and prompts change and make program operation very obvious. This is a real friendly program.

MyLabelMaker comes with 100 free 3-1/2" by 15/16" tractor-feed self-stick labels, and sells for \$24.95. "MyAdvancedLabelDesigner for Windows" sells for \$59.95. **NV**

Fred Blechman has written over 650 magazine articles and five books about electronics and microcomputers since 1956. He can be reached at (818) 346-7024 from 9AM-5PM Pacific Time Monday-Saturday.

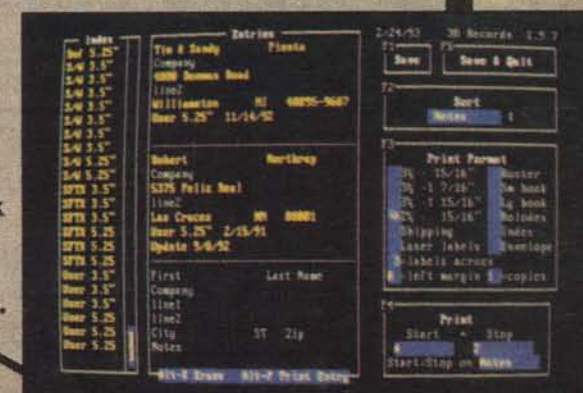
MyMailList can be sorted on different record fields. This sort is on the Last Name, as shown in the Index and the Sort windows.



MyMailList sorted by City, as shown in the Index and Sort windows.



MyMailList sorted on the first characters of the first Notes line. The movable bar at the bottom of the Index window selects the records shown in the Entries window.



When you look out on a calm lake or a slowly running stream, what do you imagine is going on beneath the surface? Calm, sleek, streamlined fish, silently gliding through the water, with barely a ripple? Pictures of the 'silent deep,' only broken by a jumping fish or an occasional rock thrown in? Well, it is anything but silent under water. Most lakes, ponds, and streams are alive with all sorts of sounds, from the grunts and grinds of catfish looking for food to the sound of a motorboat buzzing across the water a mile from you. The underwater audio world is always active, always interesting.

You can hear things like the motorboat just by listening underwater while out swimming. The sounds of the catfish are a little harder. First, most fish will not be near when you are in the water. Second, the noises they make are not very loud. To hear these things you have to have a microphone that will work underwater and an amplifier to drive a speaker.

I will detail how to build a professional quality underwater listening device in this article that you can use in any body of water (fresh or salt) and to a depth of at least 50 feet.

THE HEART OF THE DEVICE

The underwater microphone is the heart. These units are available from surplus houses (like Edmund Scientific) for very reasonable prices. As with much stuff available on the surplus market, these units were originally made for Uncle Sam. This means that you can buy a professionally manufactured component for a fraction of the original cost to the government. (This is one way to help ease the pain of paying high taxes: use equipment the government developed with your tax dollars!) Figure 1 shows the microphone unit along with the RG 178 coax you will use to make connections between the mike and the amplifier.

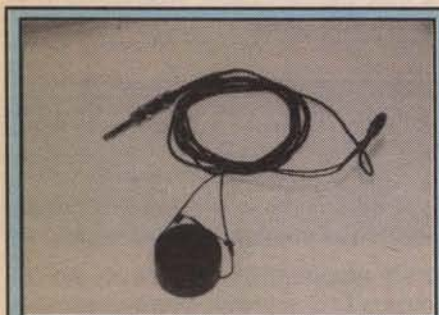


FIGURE 1
Photo of the underwater transducer, the RG 178 coax, and the phono plug.

CONSTRUCTION

Construction should begin by making the microphone extension cord. This cord is made from RG 178 coax, which is a very thin (1/8 diameter) coax

THE SILENT? DEEP

by James Melton

sometimes used for shielded hookup wire inside radio equipment. Cut the black insulation from both ends of the coax back from the end about 1 inch. Separate the inner conductor from the shield as far back as possible. You can 'unbraid' the shield conductor to do this. Next, strip about 1/4 inch of insulation from the center conductor on both ends of the coax. One end of the coax will be soldered to the microphone, and the other end will be either attached directly to the amplifier, or for a more professional look, solder it to a 1/4 inch phono plug. The inner conductor should go to the tip of the plug, and the ground or shield wire should be soldered to the outer portion of the plug.

THE AMPLIFIER

The amplifier is a two stage design that uses an operational amplifier (U1) for input impedance

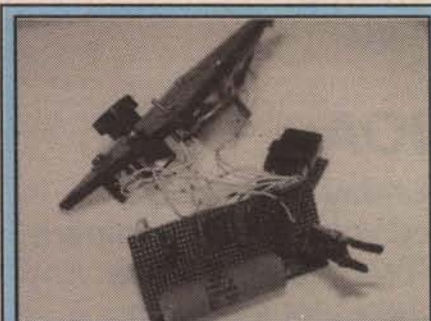


FIGURE 2
3/4 view of the amplifier showing the power amp mounted with a heatsink. Note the wiring is all wire wrapped on the board, and stranded hookup wire from the board to the other connections.

matching and a power audio amplifier (U2) for the final speaker drive. As you can see from Figure 2, the amplifier was built on a piece of perfboard using wire wrap techniques. A circuit board could be used, of course, and the circuit is simple enough that point to point wiring would work just as well. I chose wire wrap because it is well suited for audio frequencies and low power levels, and because I already have the wire wrapping equipment! Figure 3 shows the circuit board for the amplifier placed into the box, as well as the circuit board I used to mount the 9 volt battery.

The final amplifier, an LM383, is capable of up

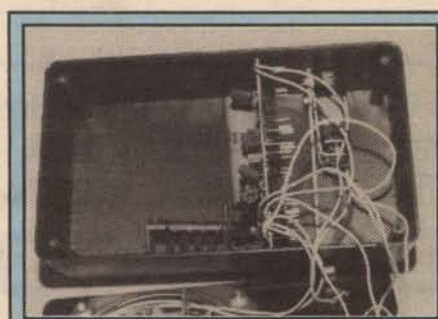


FIGURE 3
View showing the boards inserted into the box, using the side mounting rails inside the box.

to 8 watts of drive. You will not be getting this amount of power out of it (considering it is powered from a 9 volt battery) but nonetheless it can get very hot. I learned this after I had already built the board for it, and had it soldered and wire wrapped in place. This chip can get very hot if you experience feedback for very long, so to protect it from thermal destruction, mount a heatsink on it. Figure 4 shows a good view of how much heatsink is necessary. More would be ok, of course. The unit I used is 1/2 of a typical TO-5 case style heatsink. I had to cut it in half to mount the heatsink in the box! The finished box is shown in Figure 5. The amp could be made quite a bit smaller if necessary, but this size box is easy to handle and doesn't seem to tip over or move around as much as a smaller box might. This can be important if you are working and listening from a boat! I used white press-on labeling for the box, including part of one sheet that said "Made in U.S.A." People that know I made it



FIGURE 4 Another view showing the box ready to have the lid put on. Note how clean and uncluttered the perfboard layout is.

seem to appreciate that touch. The battery will last long enough so that you do not need to buy a box that has a battery door — just open it up when your battery runs low and put in a new one.

THEORY OF OPERATION

The underwater microphone represents a nominal 600 ohm impedance to the amplifier circuit. The input is capacitively coupled to the input resistor R1 through C1. The feedback resistor R2 is used to set the maximum gain of the two stage amplifier. The operating point for the op amp is formed by R3 and R4. They establish the virtual ground for the op amp at 1/2 the supply voltage so that the amp will still work even as the battery runs down.

The output of U1 is routed to the input of the audio amp U2 through C2, a 10 uF coupling capacitor. Unwanted high frequency components that might cause oscillation are shorted to ground through C5. R5 and R6 make up a voltage divider that determines the amount of gain through the IC. C3 provides the feedback for U2. Pin 4 of U2 is the power output pin. It is connected to the high side of the output capacitor C4, and the ground side of C4 is taken to one of the speaker terminals. The other speaker terminal is taken to ground.

IN USE

The underwater microphone requires no special alignment. Just plug the microphone in, lower it into the water, turn the box on, and adjust the volume control (R2) to a comfortable listening level. In fresh water you will be able to hear catfish 'grinding' almost all the time. I have observed carp eating in shallow water and heard the slurping sound they were making at the same time. There are numerous improvements to this system that come to mind: You could use two of them, spaced appropriately, to get a 'stereo' representation. This should allow you to hear the general direction the sound is coming from, assuming the microphones are aligned with your ears. Another possibility is to put the single microphone in the end of a closed-off tube. This would make a very directional microphone. Last, you could use a waterproof speaker (the mylar covered ones found in some 'shower radios') in conjunction with the microphone to make an effective underwater communications device. NV



FIGURE 5
This is the finished box, ready for a trip to the lake or your aquarium — happy hunting!

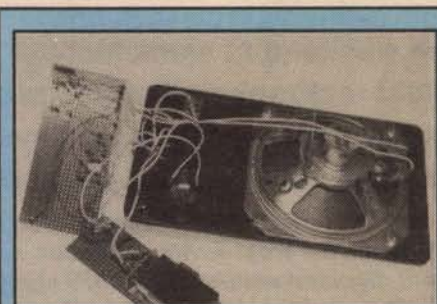
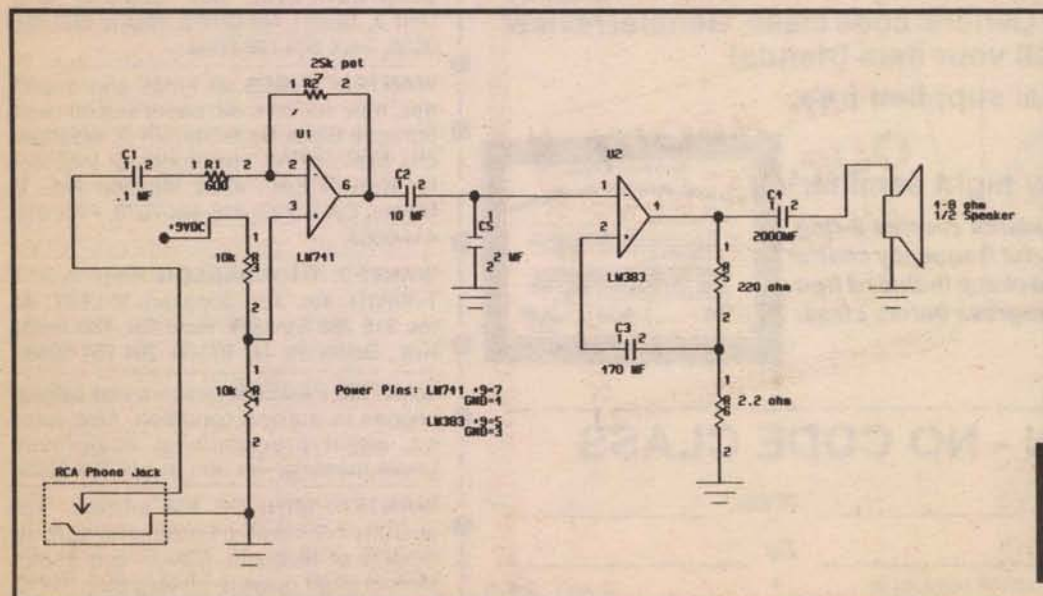


FIGURE 7 View of the underside to the amplifier, showing the minimal amount of wire wrapping required.

FIGURE 6

This is the schematic of the underwater microphone.

PARTS LIST

U1	LM741 General Purpose Op-Amp
U2	LM383 Audio Amplifier
M1	Underwater Microphone
C1	.1 mF 25 volt disc capacitor
C2	10 mF 25 volt electrolytic
C3	470 mF 25 volt electrolytic
C4	2000 mF volt electrolytic
C5	.22 mF 25 volt electrolytic
R1	600 ohm 1/4 watt 5%
R2	25 kohm potentiometer
R3,R4	10k ohm 1/4 watt 5%
R5	220 ohm 1/2 watt 5%
R6	2.2 ohm 1/4 watt 5%
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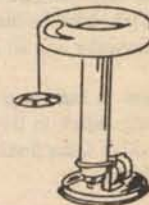
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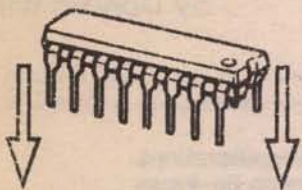
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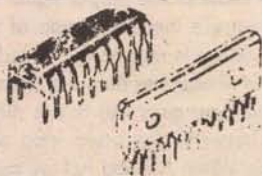
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THE SOLDERLESS BREADBOX

by Donald Wilcher

OPERATIONAL AMPLIFIER BASICS

The operational amplifier has come a long way since the days of the 10 lead metal cans and the analog computer circuits. Although analog computers can only be found in museums or tucked away in an undergrad's mechanical engineering lab, op-amps are being used in a variety of systems and consumer products. Industrial controls, automotive electronics, consumer electronic products, and children's toys are examples of the versatility of the operational amplifier. Power op-amps, in particular, are being used in audio and DC motor controls in which they can drive these devices with very little effort and dissipate a minimum amount of heat. Even though electronics hackers and experimenters are familiar with op-amps, this article will review the key characteristics of the device so that its differential amplification capabilities can be utilized more effectively.

In this month's Solderless BreadBox column, this unique and flexible analog IC will be explored through the use of hands-on experimenting of the device via, several circuits. So, without further delay, let's begin the adventure by examining some of the electrical characteristics of the operational amplifier.

The Perfect Operational Amplifier

Operational amplifiers were originally used as high performance DC amplifiers particularly in the analog computer field. Their purpose was to solve problems in science and engineering. These devices would be wired to add, sub-

tract, multiply, and do Calculus on input voltages applied to the IC. The voltages represent numbers related to the physical parameters of the problem. The gain of these amplifiers were low and therefore had to be cascaded to increase the applied input voltages. IC op-amps, today, have very high gain DC amplifiers because of the external feedback networks used to control their response. Operational amplifiers with no external feedback are described as being in an open-loop condition. In this mode, the op-amp's characteristics of the perfect device are

- 1) The open-loop gain is infinite
- 2) The input resistance is infinite
- 3) The output resistance is zero
- 4) The bandwidth is infinite
- 5) The output voltage is zero when the input voltage is zero (i.e., zero offset).

But in the real world, no op-amp can meet these five open-loop characteristics because of the inconsistencies in material and manufacturing processes used to create the chip.

The Power Supply

Operational amplifiers generally were designed to be powered from a dual or bipolar voltage supply which is typically in the range of ± 5 to ± 15 volts. To put it another way, one supply is $+5$ to $+15$ volts with respect to ground, and the other supply voltages is -5 to -15 volts with respect to ground as shown in Figure 1. But, in certain cases, the op-amp

may be operated from a single supply voltage. The supply leads of these amplifiers are usually bypassed to ground with good quality RF decoupling capacitors as shown in Figure 2. The capacitors can range from 0.1 microfarad (ceramic disc) to 10 microfarad tantalums. The LM118 wideband op-amp will require a set of bypass capacitors for each IC. General-purpose devices such as the 741 are not that critical, but it is good practice to install one set of capacitors for every five ICs. The use of these caps will prevent the amplifier from becoming an uncontrollable oscillator.

TECH TIP: Never reverse the power supply polarity to these op-amps. Applying a negative voltage to the "+V" pin and a positive voltage to the "-V" pin even momentarily will result in destructive current flow through the op-amp.

Gain and Frequency Response

Real world op-amps do not have infinite gain and bandwidth unlike the perfect op-amp. The open-loop gain of the op-amp, at very low frequencies, is quite constant. At a 6 Hz frequency, the op-amp begins to roll off. The reason for this roll-off is at a rate of -6dB/octave or -20dB/decade, the octave is doubling in frequency and the decade increases ten fold in frequency as well. This increase of frequency continues until the gain is at unity or 1dB. The frequency at which the gain is unity is called the unity gain frequency (fT).

When some of the output signal is fed back to the op-amp's input, the ratio of the output to input voltage is termed the closed loop gain (Acl) and is always less than the open loop gain (Aol). The loop gain (Al) is the difference in decibels between the open loop and closed loop gains. When Aol and Acl are expressed as

simple output to input ratios, the loop gain is expressed mathematically as: $Al = Aol/Acl$.

Other Considerations Concerning Op-Amps

The following paragraphs will discuss other important parameters of the op-amp. By understanding these characteristics, you hackers and experimenters will be able to use these chips more effectively in your design.

Input resistance: the equivalent resistance seen by an external source between the differential input terminals. The input resistance of an op-amp is usually rather high. Popular used op-amps (i.e., 741) have input resistance (Ri) between 10K and 1M with most op-amps tending toward the higher end of that range. An Ri of 250K is usually a good estimate of an op-amp's input resistance if no specification sheet is available.

Output resistance: the output resistance of op-amps ranges from 50 ohms to about 200 ohms depending on the IC type. An op-amp's effective resistance is reduced when external feedback components are connected. So in most applications using feedback, the overall input resistance is considered to be 0 ohms.

Common Mode Inputs: the op-amp is basically a differential amplifier so it should ideally amplify only the difference between the voltages appearing at the two inputs. This means that any signal component which appears simultaneously at both inputs should be completely eliminated and should not affect the output signal in any way.

Common Mode Rejection Ratio: a ratio which determines the op-amps ability to reject signals applied to its inputs simultaneously. This ratio of the common-mode input voltage to generated output voltage is expressed in decibels (dB).

The Most Commonly Used Amplifiers for Op-Amps

Although the op-amp can be configured into a multitude of circuits, amplifiers are the most obvious use of these chips. Therefore, the following paragraphs will discuss the two most widely used amplifier configurations for the op-amp.

The Inverting Amplifier

The ability of the output polarity being opposite to the input signal is what the invert-

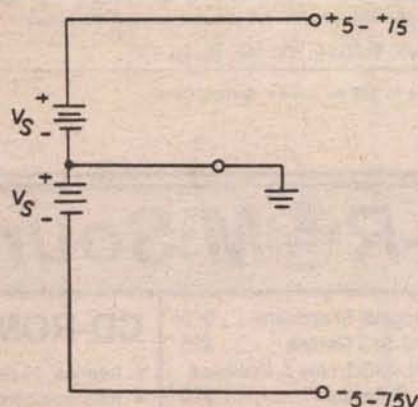


FIGURE 1 A Dual or Bipolar Voltage Supply for Op-Amps

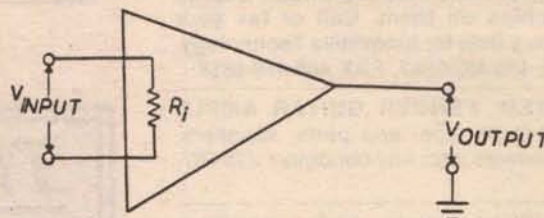


FIGURE 3 Input Resistance of an Operational Amplifier

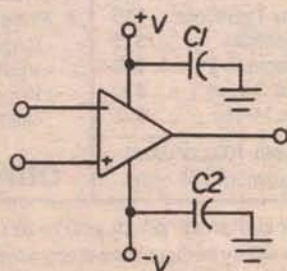


FIGURE 2 Bypass Capacitors for Power Supply Pins of an Op-Amp

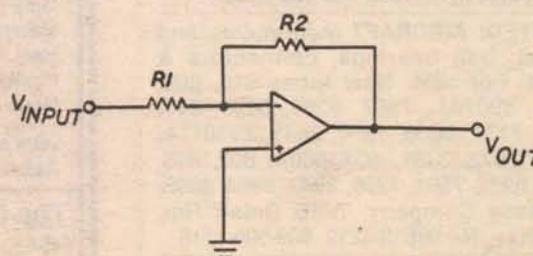


FIGURE 4 Circuit Diagram of an Inverting Amplifier

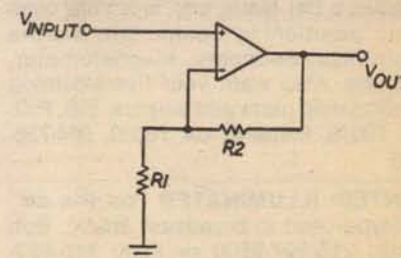


FIGURE 5 Circuit Diagram of a Non-Inverting Amplifier

ing amplifier is capable of performing. For example, if the input signal is DC, the amplified output of this signal will also be DC but opposite in polarity. Likewise, if an AC signal is applied to the input of the op-amp, the output is an amplified AC signal 180 degrees out of phase with the input. Figure 4 shows the diagram of the inverting amplifier. The resistors connected to the op-amp help to provide a negative feedback path for the applied voltage. This arrangement is called a closed loop operation. In such a configuration, the voltage gain and input impedance of the overall amplifier are almost completely dependent on the ohmic resistance values of R1 and R2 in the circuit but independent of the op-amp device. The voltage or closed loop gain of the op-amp can be calculated using the equation: $A_{cl} = R_2/R_1$ or V_o/V_i where V_o is the measured output voltage and V_i relates to the applied input voltage to the chip. The voltage gain of the inverting amplifier, consequently, can be either less than, equal to, or greater than 1, depending on the values of R2 to R1.

Non-Inverting Amplifier

The other commonly used op-amp amplifier is the non-inverting unit. As shown in Figure 5, the name implies that the output of the non-inverting amplifier has the same polarity as the input voltage. The external resistors R1 and R2 help to establish the voltage or closed loop gain for the circuit. The voltage gain of the

non-inverting amplifier can be calculated by using the equation: $A_{cl} = 1 + (R_2/R_1)$. The voltage gain of this amplifier circuit will always be greater than unity no matter how large R1 is made to be.

Op-Amp Circus of Circuits

Now that the basic op-amps have been discussed, we have reached the part of our adventure where this knowledge can be applied to practical circuits. The following paragraphs will illustrate some of these circuits through the use of hands-on experimentation. So, as always, blow the dust off of those bread boards and be prepared for another fascinating voyage investigating the operational amplifier.

A Portable Singal Tracer

As shown in Figure 6, a portable signal tracer can be created using either an inverting amplifier or a non-inverting unit. Basically, the sound or signal will enter through the test probe and will be amplified via the feedback resistors and the op-amp. To test out the circuit, use a 1 KHz signal and an oscilloscope for monitoring the amplified signal. If the circuit checks out, add the earphones to the device via pin 6 and ground.

This circuit will be a welcome edition to any electronics hacker or experimenter working on audio or radio circuits. With its ability to amplify, the op-amp will be able to find the defective

stage in either one of those electronic products quite easily.

Test Generators

As a continuation of op-amp applications, they can be used to create "mini" test generators in addition to performing amplifier functions. The frequency of these generators are fixed but can be changed by replacing the values of R and C with different values. As shown in Figure 7, a squarewave generator can be constructed quite easily using an operational amplifier. The output of the generator is fed back to both inputs of the op-amp. Again, the frequency is established by R1, R2, and C.

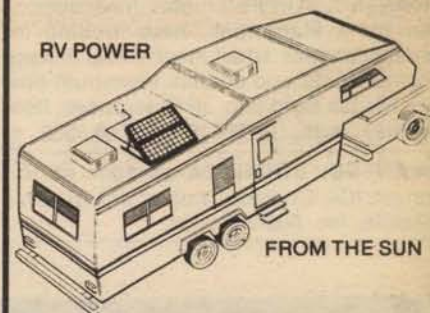
Another variation of this design is to utilize two op-amps where the squarewave output of one op-amp is fed to the second one causing it to produce a triangle waveform. Therefore, two instruments are combined into one. This circuit is also dependent on the values of R, R1, R2, and C. Figure 8 illustrates the diagram for a square/triangle wave generator.

Further Thoughts and Experimentation

Well, I hope you can see how versatile op-amps are and how they can be used to create simple, yet, useful test gear for your workshop or test bench. If you're interested in knowing how op-amps can be used to drive DC motors, see last month's Solderless BreadBox column. Enuf said, see ya next month in the breadbox! NV

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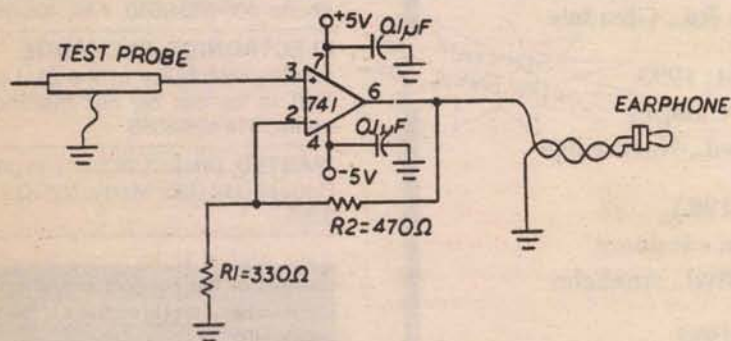


FIGURE 6

Circuit for a Portable Signal Tracer

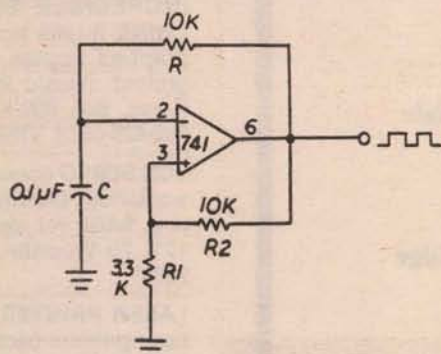


FIGURE 7

A Squarewave Generator Using an Op-Amp

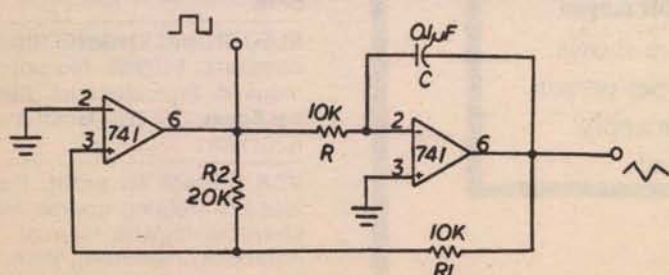


FIGURE 8

A Square/Triangle Wave Generator



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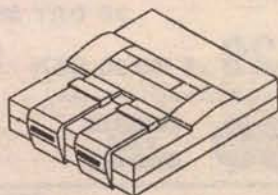
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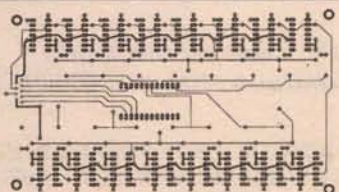
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JULY 24-25

CO - Woodland Park - MARC Swapfest Campout
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NH - Manchester - New England Division ARRL Convention
OK - Oklahoma City - CORA Ham Holidays '93

JULY 24-25-26

NE - Anselmo - Central Nebraska ARC Hamfest

JULY 25

CA - Hayward - MarketPro Computer Shows*
CA - Lancaster - MarketPro Computer Shows*
CA - Santa Ana - ACP Swapmeet
IL - Glen Ellyn - Computer Central*
MA - Fall River - Northern Computer Shows & Sales
MD - Baltimore - Baltimore Radio ATS Hamfest/Computerfest
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PA - Monroeville - Tri-State Computer Fairs*

JULY 30-31

MI - Manistique - Manistique ARA '93 U.P. Hamfest

JULY 30-31-AUGUST 1

CANADA - Regina - Saskatchewan - Regina Hamfest '93

JULY 31

CA - Northridge - California Computer Show & Sale*
NY - Albany - Tri-State Computer Fairs*
NY - Edison - KGP's Computer Show*

JULY 31 - AUGUST 1

CA - San Francisco - California Computer Show & Sale*
FL - Jacksonville - Florida State Convention
NJ - Lawrenceville - Star Ware PC Dealer Showcase

AUGUST 1993

AUGUST 1

CA - Glendale - California Computer Show & Sale*
CO - Colorado Springs - R&L Computer Fair & Flea Market*
IL - Sugar Grove - Fox River Radio League Hamfest
IN - Crooked Lake - Land of Lakes Angola Hamfest
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NC - Charlotte - Charlotte ARC Queen City Hamfest/Cmptrfair
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AUGUST 4-5-6-7

IL - Elgin - Antique Radio Club of IL Radiofest 1993

AUGUST 6-7-8

AR - Lakeview - The 3905 Century Club Eyeball
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AUGUST 7

CA - Oakland - California Computer Show & Sale*
CA - Santee - Electronics Swap Meet
CT - New Haven - PC Fest Computer Shows*
OH - Columbus - Aladdin Amateur Radio Club Hamfest
PA - Bethlehem - Musicians Flea Market
SC - Columbia - Palmetto PCC Columbia Hamfest/Cmptrfest

AUGUST 7-8

CA - Pomona - Computer Marketplace Trade Show
GA - Marietta - Atlanta Area Computer Show

AUGUST 8

CA - Sacramento - California Computer Show & Sale*
CA - San Diego - MarketPro Computer Shows*
CA - San Rafael - MarketPro Computer Shows*
IL - Peotone - Hamfesters Radio Club Hamfest
KY - Frankfort - Bluegrass Amateur Radio Club Hamfest
NY - Albany - PC Fest Computer Shows*
NY - White Plains - Eastern NY Section Convention
OH - Paulding - Paulding County ARG 3rd Annual Hamfest
OH - Randolph - Portage Amateur Radio Club Hamfest
PA - Warrington - Mid-Atlantic ARC Hamfest

AUGUST 13-14-15

CT - Vernon - Eastern VHF/UHF/SHF Conference

AUGUST 14

CA - Los Altos Hills - Foothill College Flea Market
CA - Northridge - California Computer Show & Sale*
CA - Oceanside - Oceanside Swap Meet
CA - Santa Rosa - MarketPro Computer Shows*
MA - Fall River - Northern Computer Shows & Sales
MA - Springfield - PC Fest Computer Shows*
VT - Charlotte - BARC 41st International Hamfest '93
WA - Tacoma - Radio Club of Tacoma Electronics Fleamkt
WI - Rhinelander - Northwoods ARC Swapfest

AUGUST 14-15

AL - Huntsville - ARRL National Convention
CT - Vernon - 19th Eastern VHF/UHF Conference

AUGUST 15

CA - Hayward - MarketPro Computer Shows*
CA - Oxnard - MarketPro Computer Shows*
CA - Pleasanton - California Computer Show & Sale*
DE - Georgetown - Sussex ARA Hamfest
IL - Cedar Rapids - Cedar Valley ARC Hamfest
IL - Quincy - Western Illinois ARC Hamfest
MA - Boxborough - PC Fest Computer Shows*
MA - Cambridge - MIT Radio Society/Harvard Hamfest
MI - Saginaw - Saginaw Valley ARA Ham Radio Swap
NH - Bedford - Northern Computer Shows & Sales
OH - Warren - Warren ARA Hamfest
PA - Easton - Delaware Lehigh Amateur Radio Club Hamfest

AUGUST 21

CA - Anaheim - California Computer Show & Sale*
CA - Santee - Electronics Swap Meet
CO - Denver - R&L Computer Fair & Flea Market*
NJ - Oakland - Ramapo Mountain ARC Hamfest
NY - Ithaca - Tompkins County ARC Hamfest/Computerfest
VA - Norfolk - Tri-State Computer Fairs*
VA - Tysons Corner - CMA Computer Shows*
WA - Longview - Lower Columbia ARA Swap Meet

AUGUST 21-22

LA - Bossier City - Shreveport ARA Hamfest
NM - Albuquerque - Duke City Hamfest/ARRL Section Conv
PA - King of Prussia - Valley Forge Hamshows 1993

AUGUST 22

CA - Sacramento - MarketPro Computer Shows*
MA - Peabody - Northern Computer Shows & Sales

MD - Towson - Moose ARC Ham & Computerfest
MO - St. Charles - St. Charles ARC Hamfest
OH - Marysville - Union County ARC Hamfest/Computer Show

AUGUST 27-28-29

LA - New Orleans - Operating Specialty DX Convention

AUGUST 28

CA - Pomona - Computer Marketplace Trade Show
CA - Vallejo - MarketPro Computer Shows*
GA - Madison - Confederate Signal Corps Hamfest
MN - Roseau - Lake of the Woods Repeater Assn. Hamfest
NY - Chaffee - Snowbelt Ham & Computer Fest
TX - Gainesville - North Texas Section Convention
TX - Victoria - Victoria Amateur Radio Club Hamfest

AUGUST 28-29

OH - Dayton - Dayton Microcomputer Computerfest 1993

AUGUST 29

CA - San Rafael - MarketPro Computer Shows*
IL - Danville - Vermillion County ARA Hamfest
MI - Owosso - ARRL Michigan State Convention
NJ - Mullica Hill - Gloucester County ARC Hamfest
NY - Yonkers - Yonkers ARC Hamfest
TN - Lebanon - Short Mountain Repeater Club Hamfest

SEPTEMBER 1993

SEPTEMBER 3-4

NM - Alamogordo - Alamogordo ARC Hamfest

SEPTEMBER 4

CA - Santee - Electronics Swap Meet
CA - Ventura - MarketPro Computer Shows*
MD - New Carrollton - CMA Computer Shows
NY - Middletown - Tri-State Computer Fairs*
OH - Troy - Miami County Amateur Radio Club Hamfest

SEPTEMBER 4-5

NC - Shelby - Shelby ARC 36th Annual Hamfest

SEPTEMBER 5

CA - Livermore - Livermore ARC Swap Meet
CA - San Diego - MarketPro Computer Shows*
CO - Colorado Springs - R&L Computer Fair & Flea Market*
IA - Burlington - Iowa-Illinois ARC Hamfest
IN - Indianapolis - Central Indiana Hamfest/Computerfair

SEPTEMBER 6

MI - Southfield - Michigan Computer Festival
NJ - Secaucus - Tri-State Computer Fairs*

SEPTEMBER 9

OH - Toledo - Toledo Computer Festival

SEPTEMBER 10-11-12

FL - Melbourne - Platinum Coast ARS Hamfest

SEPTEMBER 11

CA - Los Altos Hills - Foothill College Flea Market
CA - Oceanside - Oceanside Swap Meet
CO - Denver - R&L Computer Fair & Flea Market*
GA - Statesboro - Statesboro ARC Hamfest
IN - Ft Wayne - Ft Wayne RC Hamfest & Computer Show
IN - Highland - Computer Possibilities Unlimited
IN - LaPorte - LaPorte ARC Summer Hamfest
KS - Chanute - Chanute Area ARC Hamfest
MI - Cape Girardeau - Missouri Superfest '93
PA - Erie - Radio Association of Erie Hamfest
VA - Tysons Corner - CMA Computer Shows*

SEPTEMBER 12

CA - Palm Springs - Spectrum Marketing Computer Show
CA - Santa Rosa - MarketPro Computer Shows*
DE - New Castle - Tri-State Computer Fairs*
IL - Du Quoin - Shawnee ARC Hamfest
IL - Joliet - Bolingbrook ARS Hamfest
MD - Gaithersburg - Foundation for Amateur Radio Hamfest
MO - Monett - Ozarks ARS Hamfest
OH - Findlay - Findlay ARC Hamfest
PA - Butler - Butler Radio Assoc Hamfest

SEPTEMBER 17-18-19

CA - Ventura - Southwestern Div ARRL Convention

SEPTEMBER 18

CA - Santee - Electronics Swap Meet
CA - Vallejo - MarketPro Computer Shows*
CA - Victorville - Spectrum Marketing Computer Show
MA - South Dartmouth - GroupNet Communications Show
MI - Hudsonville - Grand Rapids ARA Hamfest
NM - Santa Fe - Northern New Mexico ARC Hamfest
NY - Buffalo - Rochester Amateur Radio Club Hamfest
PA - Berwick - Columbia-Montour ARC Hamfest/Cmptrfest
VA - Richmond - PC Fest Computer Shows*

SEPTEMBER 18-19

IL - Peoria - Peoria Area ARC Superfest '93

SEPTEMBER 19

AZ - Phoenix - Computer & Electronic Swap Meet
AZ - Scottsdale - Family Amateur Radio Event at Rawhide
CA - Lancaster - MarketPro Computer Shows*
CT - Sandy Hook - Candlewood ARC Hamfest
DE - Newark - PC Fest Computer Shows*
IL - Orland Park - Chicagoland Computer Fair
MA - Cambridge - MIT Radio Society/Harvard Hamfest
MI - Mount Clemens - L'Anse Creuse ARC Swap & Shop
NJ - Pennsauken - South Jersey Radio Assn Hamfest
OH - Cincinnati - Greater Cincinnati ARA Hamfest

SEPTEMBER 24-25-26

KS - Wichita - 1993 Kansas State ARRL Hamvention

SEPTEMBER 25

MI - Westland - Great Lakes Computer Show & Sale
NY - Horseheads - Elmira Amateur Radio Assn Hamfest
VA - Danville - Danville ARS & South Boston RC Hamfest

SEPTEMBER 25-26

IL - Grayslake - Chicago FM Club Radio Expo '93
PA - York - Keystone VHF Club, York ARC & Hilltop Hamfest

SEPTEMBER 26

CA - Oxnard - MarketPro Computer Shows*
CA - Sacramento - MarketPro Computer Shows*
CA - Santa Ana - ACP Swap Meet
CT - Vernon - Natchaug ARC Hamfest
FL - New Port Richey - Suncoast ARC Pasco County Hamfest
IL - Glen Ellyn - Computer Central*
IL - Springfield - Sangamon Valley New Berlin Hamfest
MO - St Peters - St Peters ARC Hamfest
NC - Butler - Falls Lake ARC Annual Swapfest
NJ - Cherry Hill - Tri-State Computer Fairs*
NY - Yonkers - Metro 70cm Network Flea Market
OH - Berea - Cleveland Hamfest Assoc Hamfest

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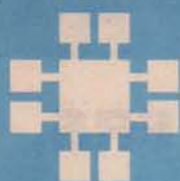
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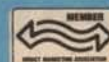
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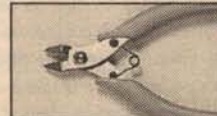
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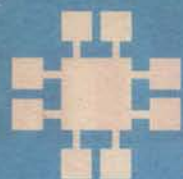
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7405	.29	74LS08	.25	74LS191	.49
7406	.35	74LS10	.25	74LS193	.59
7407	.35	74LS14	.39	74LS221	.59
7408	.29	74LS20	.25	74LS240	.49
7410	.29	74LS30	.25	74LS241	.55
7414	.35	74LS32	.25	74LS244	.69
7432	.35	74LS38	.29	74LS245	.69
7447	.85	74LS42	.39	74LS257	.39
7473	.49	74LS51	.25	74LS273	.69
7474	.39	74LS73	.39	74LS293	.59
7475	.39	74LS74	.29	74LS367	.39
7476	.59	74LS75	.29	74LS373	.65
7483	.59	74LS83	.49	74LS374	.65
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7493	.45	74LS90	.39	74S00	.29
74116	1.49	74LS93	.39	74S02	.29
74121	.49	74LS107	.39	74S04	.29
74123	.49	74LS112	.39	74S08	.29
74150	1.29	74LS123	.39	74S32	.35
74151	.39	74LS125	.39	74S157	.49
74153	.39	74LS126	.39	74S163	.45
74154	1.25	74LS138	.39	74S188	1.89
74157	.45	74LS139	.39	74S287	1.69
74161	.49	74LS151	.39	74S288	1.69
74163	.69	74LS153	.39	74S373	.49
74174	.49	74LS154	1.15	74S374	.59
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VOLTAGE REGULATORS

PART#	PRICE	PART#	PRICE	PART#	PRICE
UA78540	1.35	7815K	1.39	7915T	.45
78L05	.39	7824T	.45	7915K	1.49
7805T	.45	7824K	1.39	7924T	.45
7805K	1.39	79L05	.39	7924K	1.49
78M05C	.39	7905T	.45	LM317T	.57
7806T	.45	7905K	1.49	LM323K	3.25
7808T	.45	7906T	.45	LM337K	2.95
78L12	.39	7908T	.45	LM337T	.87
7812T	.45	79L12	.39	LM338K	4.45
7812K	1.39	7912T	.45	LM350K	3.59
78L15	.39	7912K	1.49	LM350T	2.85
7815T	.45	79L15	.39	LM723	.49

4000 SERIES

PART#	PRICE	PART#	PRICE	PART#	PRICE
4001	.25	4040	.59	4066	.29
4011	.25	4046	.69	4069	.25
4013	.29	4049	.25	4070	.29
4016	.39	4050	.29	4071	.25
4017	.49	4051	.59	4093	.39
4023	.25	4052	.59	4538	.89

LINEAR

PART#	PRICE	PART#	PRICE	PART#	PRICE
MAX232	3.95	LM358	.49	NE602AN	1.95
LM301	.39	LM380	.99	LM741	.29
LM307	.39	LM380N-8	1.29	LM747	.59
LM308	.65	LM393	.35	LM1458	.39
LM309K	1.49	LM555	.29	LM1488	.39
LM311	.39	LM556	.49	LM1489	.39
LM317K	1.99	NE558	.69	LM1881	4.95
LM318	.99	LM565	1.49	LM3900	.49
LM324	.35	LM566	1.19	LM3909	1.39
LM339	.39	LM567	.55	LM3914	2.19

LIGHT EMITTING DIODES

PART#	DESCRIPTION	PRICE
MAN72	7-SEGMENT .3" COMMON ANODE LED	.99
MAN74	7-SEGMENT .3" COMMON CATHODE LED	.99
LED-JR	JUMBO T1-3/4 RED LED	.10
LED-JG	JUMBO T1-3/4 GREEN LED	.14
LED-JY	JUMBO T1-3/4 YELLOW LED	.14
LED-JB	JUMBO T1-3/4 BLUE LED	2.25

EPROMs

PART#	ORG	SPEED	Vpp	PINS	PRICE
2732A-200	4096 x 8	200ns	21V	24	4.25
2764A-250	8192 x 8	250ns	12.5V	28	3.95
27128A-200	16384 x 8	200ns	12.5V	28	4.75
27256-250	32768 x 8	250ns	12.5V	28	4.75
27C256-250	32768 x 8	250ns	12.5V	28	4.45
27C512-150	65536 x 8	150ns	12.5V	28	6.25
27C101-150	131072 x 8	150ns	12.5V	32	8.25
27C201-150	262144 x 8	150ns	12.5V	32	10.95
27C401-150	524288 x 8	150ns	12.5V	32	29.95
27C401-120	524288 x 8	120ns	12.5V	32	32.95

STATIC RAM

PART#	ORG	SPEED	PINS	CMOS	LP	PRICE
HM6116LP-2	2K x 8	120ns	24	Y	Y	2.95
HM6116LP-15	2K x 8	150ns	24/3"	Y	Y	3.59
HM6264LP-10	8K x 8	100ns	28	Y	Y	4.95
HM6264LP-10	8K x 8	100ns	28/3"	Y	Y	5.49
HM62256LP-10	32K x 8	100ns	28	Y	Y	6.19
HM62832-20	32K x 8	20ns	28/3"	Y	Y	12.95
55257B5PL-10	32K x 8	100ns	28/3"	Y	Y	7.95
HM628128LP-10	128K x 8	100ns	32	Y	Y	19.95
HM628128LP-85	128K x 8	85ns	32	Y	Y	21.95

EEPROMs

PART#	ORG.	SPEED	# PINS	CMOS	PRICE
2816-450	2K x 8	450ns	24		3.55
2816-250	2K x 8	250ns	24		4.45
2816-150	2K x 8	150ns	24		5.45
28C16-250	2K x 8	250ns	24	Y	5.45
28C16-150	2K x 8	150ns	24	Y	5.95
28C4-250	8K x 8	250ns	28		7.95
28C64-250	8K x 8	250ns	28	Y	8.25
28C64-150	8K x 8	150ns	28	Y	8.95
28C256-250	32K x 8	250ns	28	Y	29.95

SERIAL EEPROMs

PART#	ORG.	# PINS	CMOS	PRICE
93C06	256 bit, 5V	8	Y	1.49
9346	1024 bit, 5V	8		1.95
93C46	1024 bit, 5V	8	Y	2.25
93C56	2048 bit, 5V	8	Y	2.95
93C66	4096 bit, 5V	8	Y	4.95

8000 SERIES MICROPROCESSORS

PART#	PRICE	PART#	PRICE	PART#	PRICE
8031	3.65	82C55-5	4.95	80486-33	499.95
8032	6.95	8742	14.95	8087	89.95
80C32	8.95	8748H	8.95	8087-2	129.95
8085A	3.19	8749H	9.95	8087-1	169.95
8088-1	6.95	8751H	29.95	80287-XL	74.95
8155	3.69	87C51	39.95	80387-SXP	74.95
8251A	3.49	8755A	14.95	80387-DXP	79.95
8253-5	2.79	R80286-16	24.95	80487-SX	369.95
8255-5	2.95	80386-33	119.25	ODP486-SX20	329.95

GALS

PART#	SPEED	# PINS	REPLACES	IN	OUT	PRICE
16V8	35ns	20	10L8 TO 16RP8	8	8	1.95
16V8-15	15ns	20	10L8 TO 16RP8	8	8	2.25
20V8	35ns	24/3"	14L8 TO 20RP8	20	8	2.95
20V8-15	15ns	24/3"	14L8 TO 20RP8	20	8	3.45
22V10	35ns	24/3"	PGM OUTPUTS	22	10	6.95
22V10-15	15ns	24/3"	PGM OUTPUTS	22	10	13.95

MOTOROLA SERIES

PART#	PRICE	PART#	PRICE	PART#	PRICE
MC1330	1.49	MC145406	2.49	68488	24.95
MC1408-8	1.49	MC146818A	4.29	68681	8.95
MC3470	1.19	MC146818P	4.95	68701	22.95
MC3479	3.95	14433	5.95	68HC000-10	15.95
MC3486	.95	14490	4.49	68HC000-12	18.95
MC3487	.95	14495	3.29	68HC000-16	21.95
MC145026	1.89	14497	6.49	68HC11AIP	16.95
MC145027	2.69	14499	3.95	68HC705CBP	18.95
MC145028	2.69	68000-12	12.95	68HC705C8S	34.95
MC145151	7.95	68230-10	9.95	68HC705KIP	5.95

DALLAS SERIES

PART#	PRICE	PART#	PRICE	PART#	PRICE
DS1202	5.95	DS1230Y	29.95	DS1283	16.95
DS1210	7.95	DS1231-20	5.95	DS1286	19.95
DS1213B	15.95	DS1232	3.95	DS1287	16.95
DS1215	11.95	DS1233	2.69	DS1387	24.95
DS1216B	24.95	DS1237-1	13.95	DS1613C	23.95
DS1220Y	12.25	DS12434Y	29.95	DS1632	5.95
DS1225Y	19.95	DS1244Y	44.95	DS1667	11.95
DS1227	7.49	DS1259	8.95	DS2132	19.95
DS1228	6.49	DS1260	16.95	DS2400	2.39

6500 SERIES

PART#	PRICE	PART#	PRICE	PART#	PRICE
65C02	5.95	6520A	3.49	6532	3.95
6502	3.95	6522	3.79	6545A	4.95
6502B	5.95	6522A	4.95	6551A	3.79
6520	2.95	6526	11.95	6581	12.95

6800 SERIES

PART#	PRICE	PART#	PRICE	PART#	PRICE
6800	1.99	6810	1.29	6845	2.29
6802	3.49	6821	1.99	6847	10.95
6809	3.95	6823	2.95	6850	1.89
6809E	2.95	6840	2.39	6852	4.95

INTERSIL SERIES

PART#	PRICE	PART#	PRICE	PART#	PRICE
ICL7106CPL	4.95	ICL7665SCPA	3.95	ICM7216BIP1	29.95
ICL7107CPL	4.95	ICL8038CPD	3.69	ICM7231BFIPL	9.95
ICL7109CPL	9.95	ICL8211CPA	2.29	ICM7555IPA	.79
ICL7660CPA	1.79	ICM7207AIPD	7.95	ICM7556IPD	1.29
ICL7663SCPA	3.95	ICM7208BIP1	19.95		

DATA ACQUISITION

PART#	PRICE	PART#	PRICE	PART#	PRICE
ADC-0800	24.95	DAC-0800	1.89	MB40576	3.95
ADC-0804	2.95	DAC-0806	1.69	MB87020	26.95
ADC-0809	3.95	DAC-0808	1.49	MC1408-6	1.69
ADC-0816	19.95	DAC-0830	7.95	MC1408-8	1.49
ADC-0817	16.95	DAC-1020	9.95	ZN428E8	8.95
ADC-0820	10.95	DAC-1021	7.95	ZN429E8	3.95
ADC-0831	4.95	DAC-1022	7.95	ZN449E	6.95

Z80 SERIES

PART#	SPEED	# PINS	DESCRIPTION	PRICE
Z80A-CPU	4.0MHz	40	8-bit MPU	1.49
Z80B-CPU	6.0MHz	40	8-bit MPU	2.59
Z80A-CTC	4.0MHz	28	Counter Timer circuit	1.49
Z80B-CTC	6.0MHz	28	Counter Timer circuit	2.95
Z80A-DART	4.0MHz	40	Dual Asynch. Receiver/Trans.	3

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CAT NO DESCRIPTION PRICE
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These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	1	10	50
PP101NV	100mm x 150mm/3.91" x 5.91"	\$2.55	\$1.90	\$1.70
PP114NV	114mm x 185mm/4.49" x 7.28"	2.98	2.45	1.98
PP152NV	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153NV	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	1	10	50
GS101NV	100mm x 150mm/3.91" x 5.91"	\$ 3.90	\$2.98	\$2.60
GS114NV	114mm x 185mm/4.49" x 7.28"	4.80	3.49	3.20
GS152NV	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153NV	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80

Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	1	10	50
GD101NV	100mm x 150mm/3.91" x 5.91"	\$ 5.07	\$3.68	\$3.38
GD114NV	114mm x 185mm/4.49" x 7.28"	5.95	4.29	3.99
GD152NV	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153NV	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30

ETCHING CHEMICALS

FERRIC CHLORIDE A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	1	5
ER-3NV	Makes 1 pint	\$3.50	\$2.75

DEVELOPER This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO	DESCRIPTION	1	10	25
POSDEVNV	Positive Developer	\$.95	\$.80	\$.50

CIRCUIT SPECIALISTS SOLDERLESS BREADBOARDS JUMPER WIRES INCLUDED!



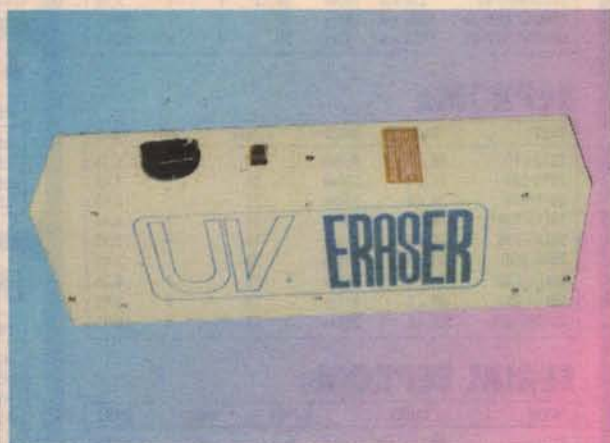
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CSI PART#	BUS STRIPS	TERMINAL STRIPS	BINDING POSTS	TOTAL CONTACT POINTS	BOARD AREA LxW	1	10	25	50
WB-102+JNV	2	1	0	830	6.5" x 2.125"	\$ 6.88	\$ 6.58	\$ 6.28	\$ 5.96
WB-102NV						5.94	5.24	4.99	4.33
WB-104-3+JNV	1	2	2	1360	6.5" x 3.125"	12.90	11.90	11.00	10.50
WB-104-1+JNV	4	2	3	1660	6.5" x 4.25"	17.90	15.66	13.96	11.97
WB-106+JNV	5	3	4	2390	6.875" x 5.75"	22.90	21.90	20.45	17.52
WB-108+JNV	7	4	4	3220	7.25" x 7.5"	31.90	29.90	27.36	23.45

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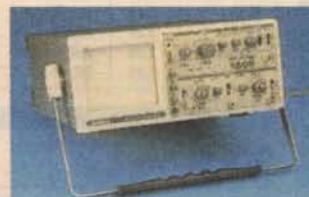


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- 24pcs Capacity (28 pin)
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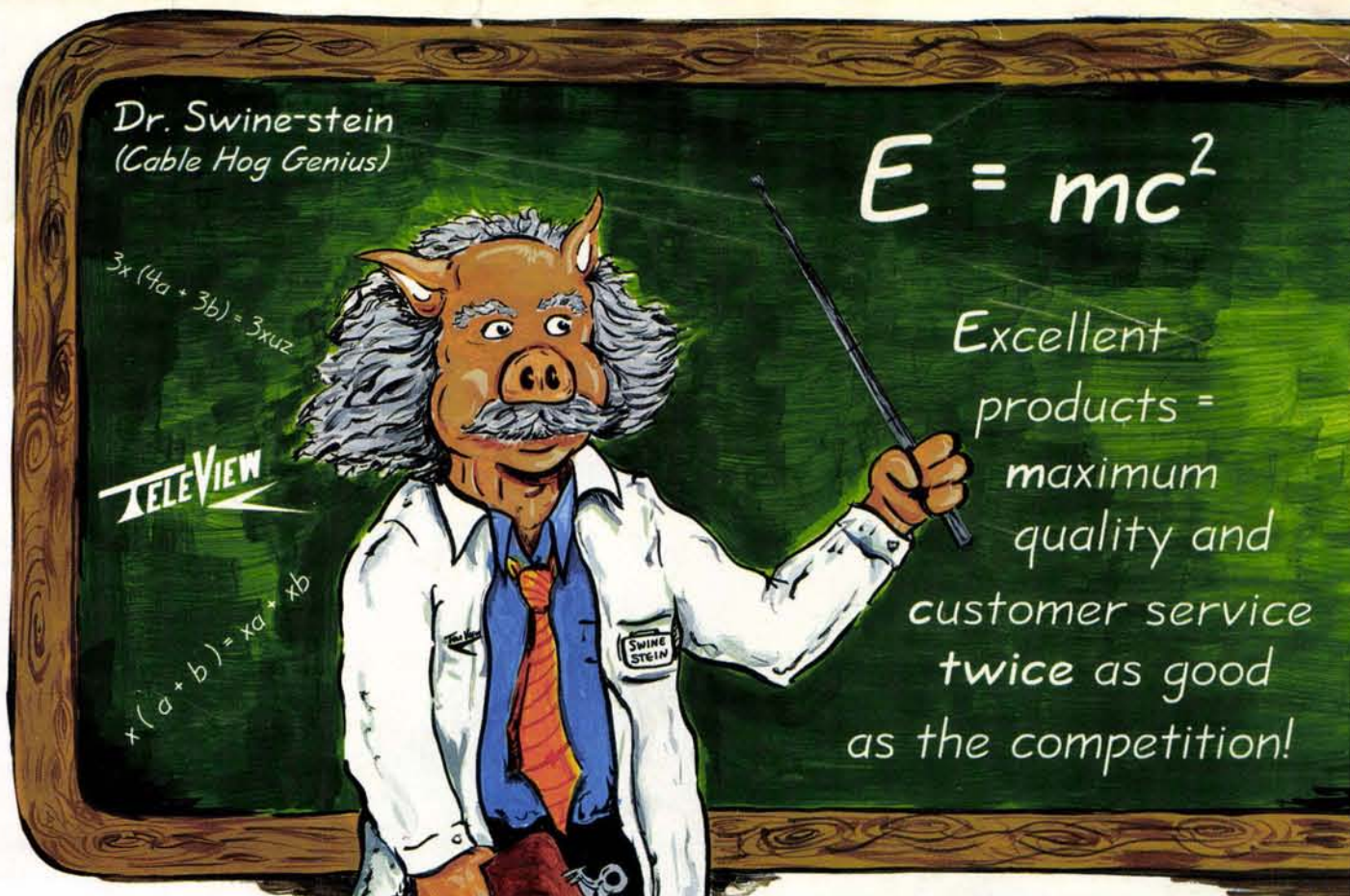
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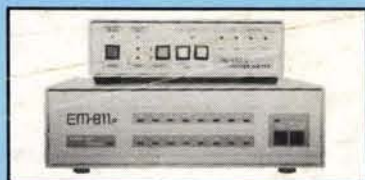
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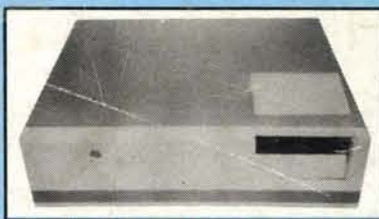
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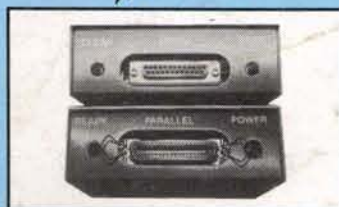
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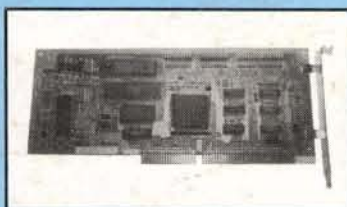
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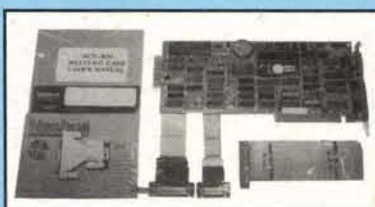
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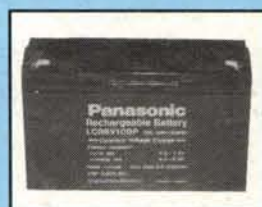
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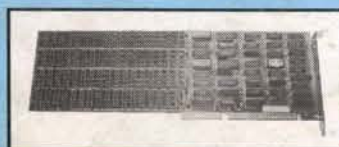
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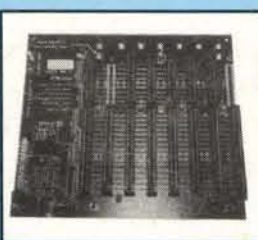
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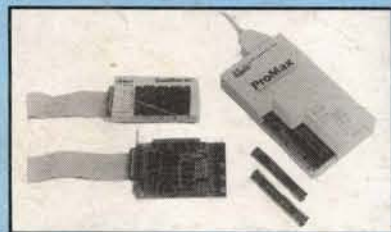
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